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Tuning In on 2024

BY HARVEY WHIPPLE
Editor CONCRETE

IF IT should be possible for us to tune in, with some Celestial radio, on the second cement centennial in the year 2024, our amazement would doubtless be no less than that of Joseph Aspdin if in spirit he listened in on the cement centennial celebration of the Portland Cement Association in Chicago last month.

There was a forward-looking note in the whole program that far outweighed in importance to the cement people and to the construction industry and the public, the pleasant and sometimes humorous recital of pioneering reminiscence.

It was agreed that "the first hundred years are the hardest"—if not with good concrete at least with the men who have buffeted the adversities of establishing a new material—and at times an untractable and unrefined material—in the confidence of conservative engineers and a public that invariably suffers from the pain of a new idea and from the ponderous immobility of human inertia.

Now we have got where we can be a little more comfortable with something to jingle in our pockets. In such a situation inertia again becomes an adversary and we are prone to settle down, leave well enough alone and to regard the specifications as finished when the committee got through with them in 1921.

But it is not so. The cement manufacturers are looking to the future. A sufficient number of the forward-looking see enough achievements unachieved so that the whole industry promises to be well leavened by their rising tendencies.

The cement using public should be glad to have the door of the cement producers' meeting opened just a crack and to catch a word now and then of constant efforts at accident prevention, conservation—economies of production intensively studied—of waste heat boiler equipments to use the B. t. u.'s that are lost up the stack and add to the cost of our product, and many, many words about better cement—a long, imagination-stirring report from a learned doctor from abroad, of early hardening cements, of new rock mixtures and quick high strengths—with discussion that promises the cement user, within five years perhaps, an entirely different cement situation.

If we do not guess very badly, the user will have cements for special purposes from which to choose, and all his works will be better served. Long before the places are laid for the banquet of 2024, the cement achievements of today may have dwindled until they seem almost as futile as the labors of the early pioneers, burning their cement clinker experimentally in the kitchen stove as late as the early seventies.

* * *

Crazing

THE means of control of the quality of concrete on the job are being studied by a great many workers in the field. This is the topmost subject of technical importance, and preliminary announcements of the American Concrete Institute indicate that it will have the lion's share of attention at the next convention in February.

A phase of the subject which has baffled many students of good practice is involved in *crazing*—the tendency of some concrete under certain conditions to develop minute hair checks. There are many things commonly "believed" about crazing, but there is a lack of definite data. Some of the considerations being gone over by a new committee of the Institute indicate that it is not an altogether simple subject, and repeating the committee's tentative inquiry serves to indicate along what lines the committee's work may develop.

It is granted that crazing is due to shrinkage. Is this shrinkage due to:

Cement—Notwithstanding that brands A, B, C, etc., all pass the present standards, they are quite likely totally different.

Aggregate—What effect has the size, the grading, the voids, the impurities, etc.?

Water—What effect has too little or too much, and what is the effect of the impurities?

Air—Its humidity and temperature are constantly changing. How do these changes affect shrinkage?

XC—A group of variables always constantly present, including the personal element coming in in many places, the nature of the forms or molds used, or the backing, or the sub-grade, the nature of the concrete itself in regard to its ability to retain or give up water, the effect of air currents, etc., ad infinitum.

Unusual Conditions on Cement Mill Foundation Job

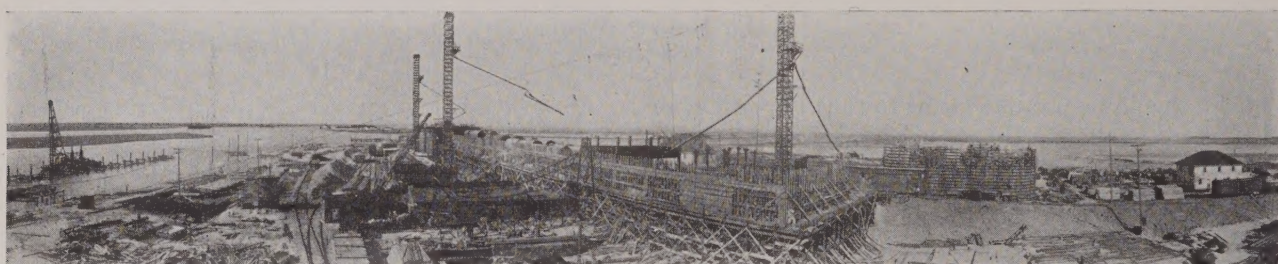
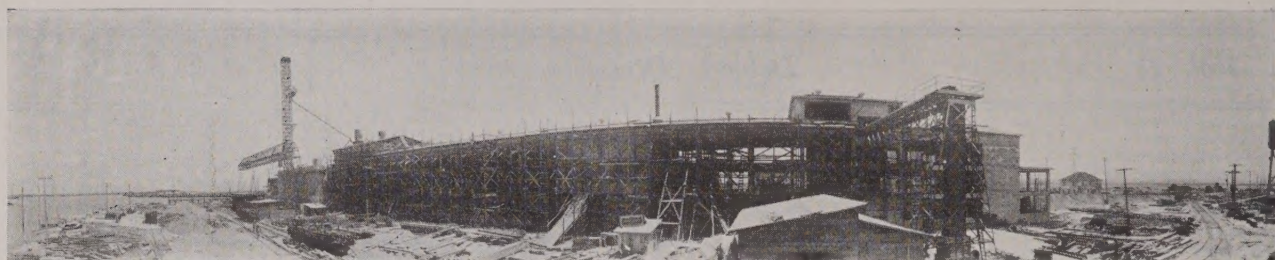


FIG. 1—(TOP) GENERAL VIEW OF NEW CEMENT PLANT UNDER CONSTRUCTION FOR PACIFIC PORTLAND CEMENT CO., SHOWING LOCATION WITH RESPECT TO SAN FRANCISCO BAY. FORMS ARE IN PLACE FOR REINFORCED CONCRETE MAIN BUILDING AND FOR THE STORAGE BUILDING

FIG. 2—(ABOVE) PART OF THE MAIN BUILDING WITH FORMS REMOVED

FIG. 3 — (LEFT) THE CEMENT PLANT FROM THE WATERFRONT WITH UNLOADING CRANE FOR HANDLING RAW MATERIALS, IN THE FOREGROUND

FIG. 4—(BOTTOM) RAW MATERIAL STORAGE PROVIDED BY SINKING REINFORCED CONCRETE CYLINDERS TO SOLID CLAY 30 FT. BELOW THE NORMAL SURFACE OF THE GROUND

Foundations for Heavy Equipment Extended Through 30 Ft. of Silt

New Cement Plant of the Pacific Portland Cement Company Consolidated, at Redwood City, Calif.

By W. C. STEVENSON

Very unusual foundation conditions governed the construction of a new plant of the Pacific Portland Cement Co., Consolidated, at Redwood Harbor, Calif., and resulted in design and construction features quite out of the ordinary. The soil was such that a 30-ft. pile would sink out of sight by its own weight. In the construction of storage cylinders a "slip form" system was used but it was the concrete that slipped down while the forms were supported from a craneway.

Materials to be used in this plant in making cement consist of oyster shells mixed with silt which will be dredged from under the waters of San Francisco Bay. As the dredging operation deposits the material on barges, the plant had to be so designed that material could be unloaded from the floating barges.

The mill's location had to be such that either rail or water shipment in and out of the mill could be taken care of with short hauls from the raw material beds and to the markets for cement. In order to fulfill these requirements the location was decided upon at Redwood Harbor, Calif., shown in Fig. 1. in reference to the waters of San Francisco Bay. The railroads in the picture are a part of the Southern Pacific system. The shell deposit in the bay comes within a mile of the plant which is 25 miles from San Francisco and about 20 miles from San Jose, thus meeting all the requirements.

It was in meeting these site requirements that serious soil conditions for foundations were encountered. The supporting strata of ground under the mill is a bed of clay many hundred feet thick. The top of this clay bed is 30 ft. below the normal ground line, this 30 ft. in depth being soft mushy silt that has been deposited by flood waters from the mountains. This 30 ft. of silt is so soft that a horse cannot walk over it and a fir pile stood on its end will penetrate the 30 ft. by its own weight. The main bed of clay underneath the silt is rather soft on the top but quickly hardens into a solid stiff clay as the depth is increased. After prospecting with drill holes and test piles it was decided that fir piles from 80 to 85 ft. long would give the required support. In driving the piles the *Engineering News* formula was used and no difficulty was experienced in obtaining a safe loading condition of 25 tons per pile.

By means of reinforced concrete beams, caps and slab construction the main floor of the mill was brought up well above water level. Due to the heavy loads it was found more economical to use the beam and slab construction than to make a concrete pile extension and as a consequence the bottoms of the concrete beams are down below water table level.

The entire floor slab of the mill is monolithic, no expansion joints having been put in because the temperature of the mud underneath the floor will be so nearly constant.

The stock house and sack house basements are 3 ft. below water table level. These floors were waterproofed by laying a reinforced asphaltic waterproofing over the bottom forms and around each of the piles. On top of this waterproofing the concrete was poured and the upward force of the water or mud from below will maintain a close contact between the waterproofing and the concrete.

The building covering the mill machinery is made entirely of reinforced concrete and steel sash. Fig. 2 shows part of the building with the forms removed and the skeleton type of the structure. Columns are approximately 20 ft. center to center with a clear span of 50 ft., and the main supporting ribs are reinforced from floor to floor. The concrete roof slab and beams together with the spandrel walls and curtain wall are intended to give the necessary bracing. In order to guard against earthquake shocks, at various parts of the buildings solid walls were built from column to column so as to make a rigid structure.

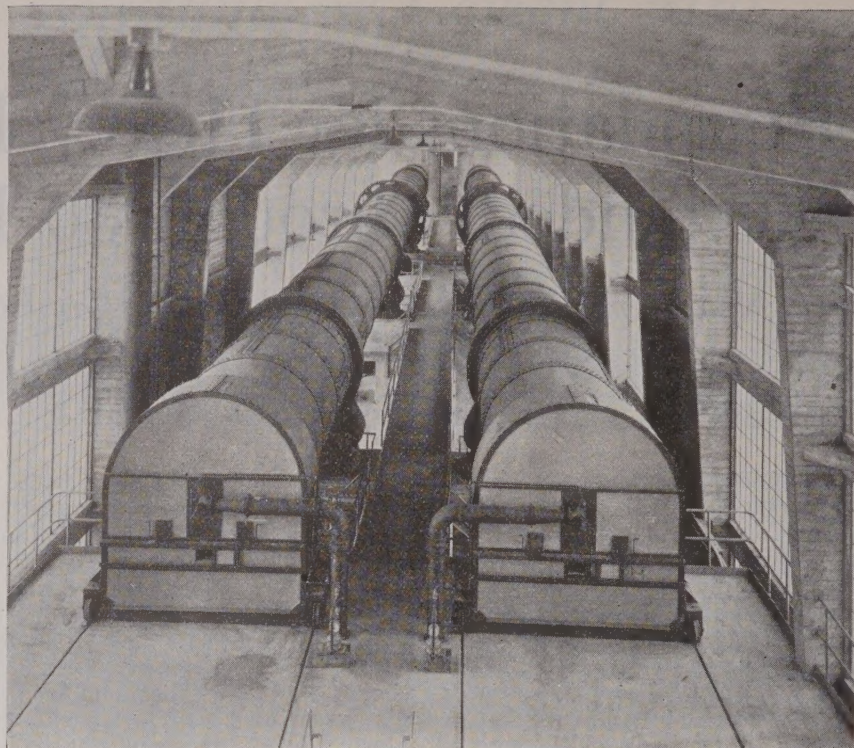
The building is provided with expansion joints and as the expansion will be greatest at the roof and practically nothing at the floor line special care was taken in the design of these joints.

The unloading crane for bringing material from the barges into the mill or into the storage is shown very clearly in Fig. 3. The crane is of the 2-rail trolley type, high speed, with a clam shell bucket of 4 yds. capacity. From the ground line to the track is 68 ft. with a total length of 340 ft. As the mill feed bins could not be constructed of a capacity sufficient to insure continuous operation of the mill it was necessary to get some ground storage of raw material. As described above, the ground has no supporting power and any load placed upon it will sink into the mud and cause a heaving of the mud on either side of the load. Consequently it would have been necessary to support the entire raw storage on a piled foundation, which was found to be very expensive, particularly because part of the storage would be in the water of the bay and not in the mud. Fir piles in the water are attacked and eaten whereas piles in the mud will not be so attacked.

In order to prevent damage to foundations by heaving of the ground due to a load placed on it, two reinforced concrete cylinders were sunk. One of these cylinders was placed in each of the two bays under the trolley crane structure. Fig. 4 shows the setting of these cylinders and their appearance. Each cylinder is 86 ft. in diameter with 20-in. reinforced walls and is 34 ft. from top of wall to bottom of cutting edge. The cutting edge was provided by tapering the concrete to a thickness of 8 in. on the bottom. No metal knife edge was used.

Stationary forms 5 ft. high were built to surround the cylinder completely above the ground. By means of

FIG. 5—INTERIOR VIEW OF KILN BUILDING SHOWING TYPE OF CONSTRUCTION AND THE TWO ROTARY KILNS



timber frames placed above the forms, large steel cables were anchored into the concrete and supported from the overhead structure through turn buckles. These forms were filled and the concrete allowed to harden, after which the turn buckles were loosened and the concrete settled into the mud slipping through the forms. It was allowed to settle into the mud about $1\frac{1}{2}$ ft. when another layer of concrete was poured, bringing the level up to the top of the forms. This program was continued until the cylinder refused to settle any more due to its own weight, which was found to be 30 ft. below the surrounding ground. No excavation was required and only a very small amount of jetting was necessary in order to have the cylinders settle into the mud to their final resting place on the clay bed. Since they have been installed and the construction supports removed there has been no settlement, and furthermore they have been loaded by dropping wet shells and mud from the bucket above and no settlement or movement has been noted on the cylinders. Thus the operation of slip form construction was reversed in a novel way. The forms were secured in place and the concrete allowed to slip out of them.

In making the pile of shells on the mud inside the cylinders, as the pile was increased the mud next inside the rim of the cylinders, which was not loaded with shells, began to heave. This heaving continued as the load was increased until it spilled over the concrete wall.

Fig. 5 is an interior view of the kiln room. These kilns are 10 ft. in diameter by 235 ft. long with a rigid shell the entire length and supported upon four carrying rollers. These mammoth kilns with four rollers revolve as smoothly as any with two rollers that the writer has ever seen.

In addition to the necessary machinery required throughout the manufacturing mill, there is provided at the plant, garages for the workmen, and washrooms with hot and cold flowing water, and in the mill, toilets, and drinking fountains throughout. Everything has been made with the idea of comfort for the workmen and ease of operation in general.

Waste Due to Seasonal Construction

The report of the committee named by Secretary of Commerce Herbert Hoover, on seasonal operation in the construction industry shows conclusively that custom, not climate, is mainly responsible for the seasonal ups and downs in building and that these evils are largely unnecessary and can be eliminated. The work of the committee, which carried on extensive research into this problem and made its report last July after the close of the fiscal year, is reviewed briefly in the annual report of the Secretary of Commerce where it is stated that for most types of construction, it is now possible to build the year round in all parts of the United States. The elimination of these wastes would strengthen the entire business structure, for construction is the balance wheel of American industry. The value of yearly construction in the United States is more than 5 billion dollars. If building falls off, there is always a slackening in many other lines of industry, resulting in unemployment, decreased purchasing power of employes and further depression.

Neither of the reports of the committee included any recommendation as to extension of governmental activities further than that there should be strengthening of the economic and physical research now being carried on by the department. It was felt that a stimulation of thought and organization in the local communities was more consonant with our National conception of individual and community initiative. Important action has now been taken in many communities in changing leasing dates and other devices to induce more regularity to construction.

Costs and Precautions in Winter Construction of Concrete Buildings

By R. E. EGELHOFF

GENERAL SUPERINTENDENT, TURNER CONSTRUCTION CO., BUFFALO DISTRICT

Henry C. Turner, president, Turner Construction Co., in a message to his organization and to clients past and prospective, says of winter construction:

The great economic gain (in winter construction) referred to by Mr. Hoover is, of course, predicated upon a uniform distribution of work throughout the year with fairly uniform employment of our man-power, both field and office, and the steady use of the capital invested, which would necessarily soon reflect itself in materially lower costs.

Can we convince business men that excellent workmanship can be performed in the building industry in the winter months and frequently at no greater cost than if performed in the following spring and summer?

Remember that exactly the same building materials are used. There need be no difference in quality and with experienced supervision, these materials can be assembled and erected fully as well in one season as in the other.

In other words—I can say, from my own experience, that it is entirely practicable to do the same grade of work throughout the entire twelve months of the year. We have demonstrated this time and time again during the past twenty years. * * *

The success of winter construction is based on competent supervision and the protection of the work against snow and ice. No owner need hesitate to proceed with winter construction if he has selected a competent architect and a competent builder. * * * It must be admitted that certain costs are encountered, such as labor and material required for canvas covering, salamanders or stoves, coke and steam lines, which are not necessary in warm weather. These items of additional cost may total three, four or five percent of the cost of the work, depending upon the size and character of the work. When the cost of installing the work of all the finishing trades is included, this percentage of additional cost is further reduced.

How are these costs offset? Prices of building materials as well as wages are dependent upon supply and demand. In the late fall and winter very frequently these prices can be shaded, sub-contractors desire to keep old, experienced superintendents, foremen and workmen employed and will shade prices to do so.

Labor costs are affected both by wage rates and production. At the present moment, workmen in some localities are accepting lower wages to secure employment for the winter, bonuses are coming off, and the opportunity presented in the late fall and winter to select workmen, to discharge the inefficient, makes possible lower production costs. The change from a shortage of mechanics to a surplus has frequently made possible a reduction of as much as ten to fifteen percent in labor costs.

Further, our cost records over many years show that similar work done under similar wage conditions costs no more in direct labor in the winter months than in mild weather.

The saving effected in buying materials and sub-contracts, in lower wage rates, may very well offset the added costs of canvas and heat.

This message introduces in the current issue of *Turner Constructor* the accompanying article by Mr. Egelhoff, which is supplemented by a "suggested specification for winter protection" in reinforced concrete building construction.

Tests show that if portland cement concrete is frozen before it sets and is then thawed out it will gain strength very slowly even if kept at a temperature of 70°.

Concrete which is not allowed to freeze but is placed in a low temperature gains strength very slowly.

If concrete is thoroughly set up at a temperature of 70° and is then exposed to extreme cold it will not continue to gain strength as rapidly as it would if kept warm.

In carrying out reinforced concrete work in winter, therefore, the system adopted must provide sufficient continuous heat during the time in which the concrete is placed and for a period of 4 or 5 days thereafter. Special care must be taken in reposting to provide sufficient supports so that excessive stresses are not brought on concrete that has not gained its full strength due to the retarding effect on gain of strength caused by exposure to cold after the heat has been removed.

On small jobs a satisfactory method can be worked out by heating the aggregate over pipes in which wood fires are kept burning and by protecting the concrete with salt hay, etc., but for reinforced concrete buildings of any considerable size our experience of some twenty-odd years has demonstrated that the cheapest efficient method of protection is obtained as follows: heat the aggregate by piling it over perforated steam pipes or by inserting pointed steam pipes into the pile. Heat the mixing water by running steam into it. Enclose the green concrete entirely with canvas. Heat the enclosed space with salamanders burning coke.

The use of hot mixing water is of great value and it should be heated as hot as possible. The idea that portland cement is "scalded" by hot water was shown to be incorrect by experiments made by Prof. Duff Abrams (see *Proceedings American Concrete Institute*, 1918, page 90). Mixing water near the boiling point had no injurious effect. Full advantage should therefore be taken of good hot water, but warmed aggregate and hot water are not sufficient without protection of the concrete after it is placed because in cold weather concrete placed in thin sections at a temperature of 95° F. will drop to close to air temperature and freeze before it sets. In placing thin sections the heating action due to the setting of the cement is negligible and the protection offered by the wood forms is not in any way sufficient.

To raise the temperature of the fresh concrete 1° the temperature of the water must be raised about 6°, therefore if the aggregate is at a temperature of 40° and the water is heated to 150°, the fresh concrete will have a temperature of about 58°.

For a job of average size provide a 50 h. p. boiler. Run a 1½-in. steam line to within a few inches of the bottom of the water barrel at the mixer. Another 1½-in. line should be run to the sand and gravel storage. Here a grillage of 1½-in. pipe should be laid on the ground covering an area slightly smaller than the area covered by the storage pile. These pipes should be about 4 ft. on center and should be perforated with ⅜-in. to ¼-in. holes staggered on 1 ft. 6 in. centers. If the sand and gravel is stored in bins a



FIG. 1—PRACTICALLY A FULL WINTER WEATHER JOB, THE BAUSCH & LOMB OPTICAL CO. FACTORY, ROCHESTER, N. Y., BUILT BY TURNER IN 1917-1918, SHOWED WINTER WEATHER EXPENSE OF APPROXIMATELY 5.57% OF THE TOTAL COST OF THE BUILDING CONTRACT WAS SIGNED SEPT. 15 AND ENCLOSED FEB. 18.



FIG. 2—WINTER WEATHER EXPENSE WAS APPROXIMATELY 2.08% OF THE TOTAL COST OF THIS BUILDING, ERECTED BY TURNER FOR THE AMERICAN WOOLEN CO., LAWRENCE, MASS., 1918-1919. NOTE SIDE AND TOP COVERING



FIGS. 3-4—THE PICTURES BELOW ARE PROGRESS VIEWS—4 STORIES IN 4 WEEKS (NOV. 4 TO DECEMBER 2, 1915)—ON WAREHOUSE AND SALES BUILDING FOR WILLIAM H. WALKER & CO., BUFFALO, N. Y.—BUILT BY TURNER CONSTRUCTION CO.

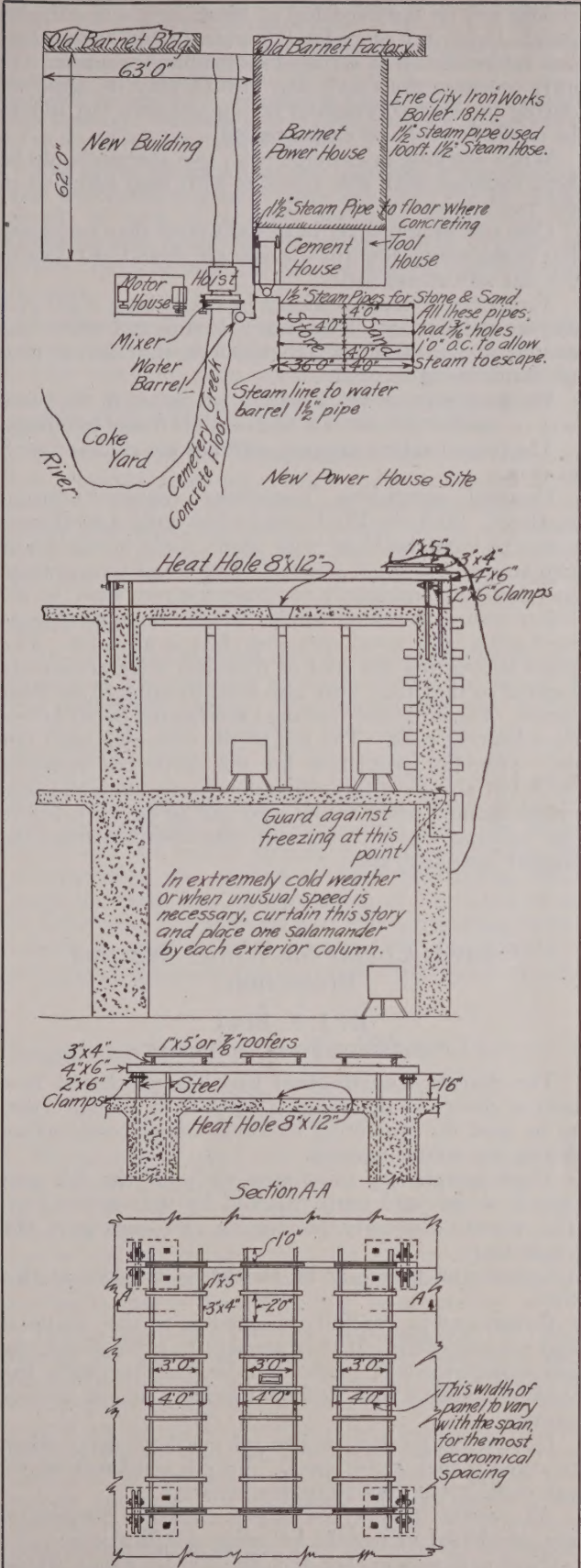


FIG. 5—PLOT PLAN OF THE BARNETT LEATHER CO. JOB, LITTLE FALLS, N. Y., SHOWING PLANT LAYOUT FOR WINTER WEATHER CONSTRUCTION

FIG. 6—SECTION THROUGH EXTERIOR BAY OF TYPICAL BUILDING SHOWING METHOD OF SUPPORTING AND HANGING THE CANVAS CURTAIN

FIG. 7—PLAN AND SECTION SHOWING SUPPORTS FOR CANVAS COVERS FOR THE TOP OF THE CONCRETE FLOOR

similar grillage of perforated pipes should be laid on the bottom.

In case the pile of material on hand at any one time is not constant enough, to warrant a grillage on the ground, use the following method: Supply three valves and connections from the steam main and to each connect a length of steam hose on the end of which attach a 6-ft. length of perforated pipe. This pipe should have its end closed and drawn to a point. Two of these perforated pipes should be driven into the gravel pile and one into the sand pile at the place where the carryalls are being loaded.

A 1½-in. line should be run up the concrete hoist and a suitable valve and connection supplied at each floor level. To this line connect the steam hose for cleaning ice and snow from the forms.

To protect the concrete as it is placed and after it has been placed hang canvas curtains from the exterior beams of the floor to be concreted and carefully lash them in under the exterior beams of the floor below, care being taken to have the canvas some distance clear of the exterior forms so as to provide a circulation of heat. Then a curtain is to be hung across the width of the building shutting off the section which is to be concreted. The salamanders should be placed so as to maintain a temperature of from 60° to 80° in this section, requiring an average of one salamander to every 300 sq. ft. of floor. As a rule place one salamander as close as possible to each exterior column and one in the center of each bay. In extremely cold weather it will be necessary to place a salamander on each side of every exterior column.

The canvas curtains should be in place and fires started in salamanders as soon as concreting is started, and in extremely cold weather the protection should be in place and fires burning several hours before concreting starts. Any accumulation of ice or snow in the forms or on the steel should be removed with live steam. But first the protection and salamanders must be in place so the condensed steam will not again form ice.

As soon as one bay of slab is concreted it should be covered immediately and the entire work closely followed with the protection. Our usual method for placing the protection over the floor slab has been to clamp 2 x 6 pieces to the column steel and then span from column to column with pieces of 4 x 6. On top of these pieces lay 3 x 4's, or still better, "Winter Weather Panels." (See sketches.) This framework should be at



FIG. 8—SALAMANDERS UNDER FORMS AND BEHIND CANVAS FURNISHING HEAT FOR FRESHLY PLACED CONCRETE AND MAINTAINING CONSTANT TEMPERATURE

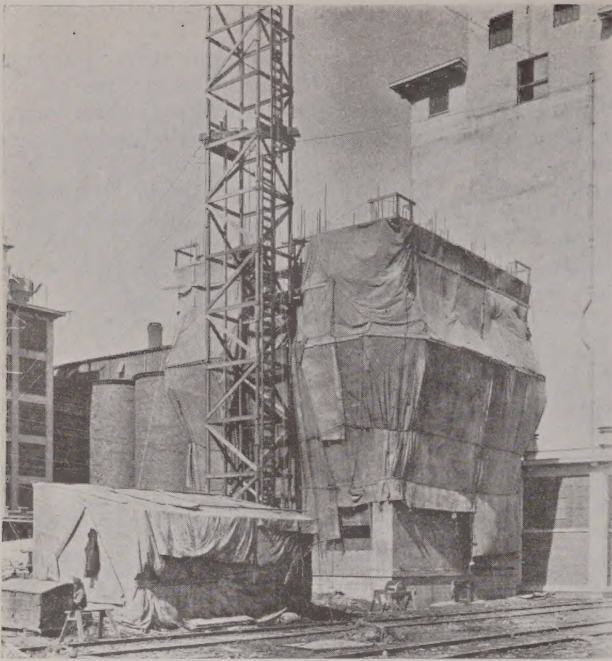


FIG. 9—GRAIN DRYING BUILDING FOR THE WYANDOTTE ELEVATOR CO., (STANDARD MILLING CO.), KANSAS CITY, KAN. SHOWS USE OF A CANVAS ENCLOSURE FOR WINTER WEATHER PROTECTION ON A SLIDING FORM OR CONTINUOUS CONCRETING OPERATION. THE CANVAS REMAINS IN PLACE AND TRAVELS UPWARD WITH THE FORMS

least 6 in. and preferably not more than 18 in. above the slab. As an alternative to the clamps on the column steel, the frame work may be supported by standards resting on the boxes forming the heat holes through the slab and this method of support has the advantage of making it easier to set column forms on mild days.

The canvases are then spread on this framework, taking care to secure them carefully and allowing good laps between adjoining pieces and with the side curtains. In heavy winds run ropes across the building on top of the canvas.

Provide one heat hole about 8 in. x 12 in. through the slab for about each 300 sq. ft. of floor area so that hot air may circulate above the slab. These boxes should have beveled sides. We must have a temperature of 50° to 70° under the top covering.

Around New York City in ordinary winter weather when using reinforced concrete beam and girder construction do not remove the top covers until 48 hours after the concrete has been placed. The side curtains may then be removed one at a time to permit of stripping one column at a time, but each side curtain should be replaced immediately and kept in place with heat going until 96 hours after concrete was placed. Flat slab construction requires more protection so top covers



FIG. 10—AS FAST AS A CONCRETE FLOOR IS POURED A FALSE WORK OF SCANTLING IS PLACED ABOUT IT AND CANVAS SPREAD OVER THIS SO THAT HOT AIR FROM THE STOVES BELOW CAN COME UP THROUGH HOLES LEFT IN THE FLOOR AND CIRCULATE ABOVE THE NEW CONCRETE WHILE IT IS SETTING

should not be removed for 72 hours and side curtains should be kept in place for 120 hours except as removed and replaced one at a time for stripping columns. On days warmer than 35°, top covers may be removed during the day to permit of setting columns but should be carefully replaced each evening.

When working in extreme cold, two stories should be kept enclosed with side curtains with heat supplied in the two stories.

Concrete should never be mixed wetter than necessary but in the winter months special care should be taken to cut out any excess water.

Temperature records should be taken both night and day at the bottom of exterior columns and under the canvas above the floor slab to know that actual protection is being secured.

Work on exterior brick walls is protected in the same way on reinforced concrete and on steel frame buildings.

The patent safety hanging scaffolds are enclosed with canvas.

Unusual conditions sometimes require unusual methods. At Lake Placid we had to build a reinforced concrete hotel building with stone walls in the lower two stories and brick above.* The usual temperature was zero and frequently the thermometer went to 20° below zero with strong winds. Under these conditions we built a light wood enclosing shed in advance. The posts supporting the roof of this shed were accurately located so that they were also used to support the floor forms. The interior of the shed was heated by air forced over heating coils. The use of the enclosing shed not only provided protection for the reinforced concrete work but also gave full protection to the stone masons, plumbers, and other trades who had to do work before the building was enclosed and heat obtained from the regular heating system.

* * *

Canvas Covers for Winter Weather Protection

By J. E. BUHL

PLANT ENGINEER, TURNER CONSTRUCTION CO.

The Turner Construction Co. has purchased new canvas covers to the value of \$30,000 in a single year, to be used for protecting buildings under construction during the winter months.

These covers are purchased early in the fall and stored in our yard until required by the various jobs. The reasons for early purchasing and storing in the yards are:

Covers can generally be purchased cheaper at this time.

Covers can be carefully checked as to size, material and workmanship. If they are sent to a job direct, the job superintendent might not be familiar with the various kinds of duck and unknowingly accept inferior canvas.

Covers can be delivered to jobs without delay when required if they are in stock. Very few manufacturers can make more than 50 covers per week.

All canvas covers for winter weather protection are purchased as per the following specifications:

Covers to be made of 12-oz. U. S. Standard Army Duck 28½ in. wide. Covers to be 20 ft. x 20 ft. finished size and must measure full size without stretching upon delivery. All sewing to be two row lock stitched with 6 stitches of 5-cord Weetamoe soft finish thread or heavier per inch. Seams to be at least 1 in. wide. A 2-in. hem is to be sewn over a ¼-in pure Manila rope all around the four sides of the cover. Each cover to be provided with a ¾ in. rope stop 6 ft. long after splicing at each corner and to have 3 additional stops on each side between corner stops. All stops to be whipped on the free end and to be spliced through a sewn-in ring. Place extra sewn-in rings in the hem midway between the above stops. All covers to

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be made with five 6-in. square patches sewed on to one side of the cover. One of these patches will be placed in the middle of the cover and the other four patches will be placed, one each midway between the center patch and each corner of the cover. To each of these patches is to be securely sewn a 1½-in. galvanized iron ring. Each cover will be stenciled in the center as follows: TURNER CONSTRUCTION COMPANY. Stenciling to be in Doric letters 4½ in. high and to be on the side of cover without patches.

The above specifications were adopted after considerable experimenting to determine proper size of cover; weight of duck to be used; necessary ropes, rings for fastening and possibility of waterproofing so that the covers could be used for rain protection the following summer.

Practically all waterproofing when applied to canvas covers makes them highly inflammable and since these covers come in close proximity to the salamanders used in heating the building under construction, it was found desirable to omit the waterproofing.

On account of the value of covers used, the company has provided a canvas storage and repair room at its shop. Two men are employed here throughout the entire year repairing canvas covers. When covers are received for storage from jobs, they are carefully spread out and dried. They are then repaired and marked with a tag showing the size of cover and put away for future use.

The company has also tried having covers fireproofed as well as waterproofed to eliminate the fire hazard of the waterproof covers. The fireproofing was applied to the cover first and then the cover was given the waterproof treatment. The treatments were applied in the order mentioned so that the waterproofing treatment would protect the fireproofing. This, however, was objectionable as no fireproofing could be found which was not readily soluble in water even when the waterproofing was applied over the fireproofing which made the extra cost of fireproofing of very little value. In some cases it was found that this fireproofing caused mildew as soon as the covers got wet and started to dry, thereby causing the canvas to deteriorate rapidly.

* * *

Suggested Specification for Winter Protection in Reinforced Concrete Building Construction

We have been asked from time to time for a specification covering the methods to be used in placing reinforced concrete in buildings during the winter months, says the *Turner Constructor*. We therefore believe that the following suggested form for use on a building of average size when built in a locality having a climate similar to that of New York may be of interest.

While reinforced concrete buildings can be built during the winter with perfect safety and at a very reasonable increase in cost, it is a fact that attempting to carry on reinforced concrete construction without proper provisions for protection is a dangerous business. Attempting to limit the placing of concrete to warm days and to thus avoid the installation of proper protective equipment is foolhardy because even if the concrete is placed on a warm day the temperature may drop during the night and stop the concrete from gaining strength. An attempt to go ahead with the reinforced concrete skeleton of a building without proper protective equipment will surely lead to unsafe work and to serious delay in the completion of the building.

Winter work has been a regular procedure for contractors experienced in reinforced concrete construction for many years. Such contractors have found that it is necessary to supply proper protective equipment

but less experienced contractors do not always realize the danger resulting from lack of proper protection. *The use of a definite specification is necessary if the owner is to have reasonable assurance of getting an undamaged building at the completion date contained in the contract.*

COLD WEATHER PROTECTION FOR REINFORCED CONCRETE WORK

1—The contractor shall furnish and install at the building boiler capacity of at least 50 h. p., licensed for 80 pounds steam pressure. This boiler capacity shall always be available for the sole purpose of supplying steam for cold weather protection.

2—All fine and coarse aggregate shall be entirely freed from frost and warmed either by storing in an enclosed space properly heated or if not stored in an enclosed heated space then by piling over perforated steam pipes having a diameter of 1½ in. and spaced about 4 ft. C to C or shall be heated by inserting 1½ in. perforated pointed steam pipes into the pile. The material piles shall be steamed during the day preceding the placing of concrete and while concreting and shall be covered with canvas during the night preceding the placing of concrete.

3—All mixing water shall be heated by injecting live steam into the water barrel at the mixer through a pipe at least 1½ in. in diameter.

4—A steam line shall be carried up with the form work and immediately before starting to place concrete, all forms and steel reinforcing shall be thoroughly cleaned and warmed by live steam supplied through a steam hose.

5—Before starting to concrete the columns of any story or the floor supported by such columns, the contractor shall hang canvases to enclose the section of the story to be concreted, being careful to maintain an air space between the exterior faces of the concrete and the canvas curtains. Canvas curtains shall be well lapped to exclude wind and shall be large enough to reach well below the surface of the floor supporting the columns which are to be concreted.

6—Before starting to concrete, salamanders containing coke fires shall be placed inside the enclosure at proper intervals to maintain a temperature of about 70° at the under side of the floor slab. This will generally require about one salamander of usual size to each 300 sq. ft. of floor space. One salamander shall be placed near each exterior column unless temperature is below 20° when two salamanders shall be placed, one each side of each exterior column. On windy days use two salamanders at each exterior column on windward side of building.

7—Holes about 8 in. x 12 in., one to about every 300 sq. ft., shall be formed through the floor slab by cutting holes in the floor form and inserting a wood frame in the concrete. These holes are to be made larger at the top of the slab than at the bottom of the slab in order to hold the concrete which will later be used to fill them. These holes permit hot air to rise into the space between the top of the slab and the canvas covers described in the next paragraph.

8—As rapidly as the floor slab is concreted it shall be covered by canvas covers well lapped and supported about 6 in. to 18 in. above the surface of the concrete by a framework supported on the wood frames around the heat openings or on the steel reinforcing rods which project above the floor line at columns. These top covers shall be well lapped over the side curtains.

9—Full continuous heat is to be maintained in each section for 110 hours after the concrete is poured, except should the outside temperature fall below 20° F. the heating shall be continued for one day for each day on which the temperature falls below 20°, but not to exceed two additional days of 24 hours each.

10—When using beam and girder construction, top covers shall be kept in place for 48 hours but with flat slab construction they shall be kept in place for 72 hours except that top covers may be removed between 8 a. m. and 5 p. m. on days when the temperature is above 35° to permit of setting column forms but shall be replaced at 5 p. m.

Side covers shall remain in place as long as heat is continued except that after 48 hours the curtains outside of exterior columns may be removed one at a time for only sufficient time to strip the forms from the exterior columns after which they should be immediately replaced.

The Editors of CONCRETE will be glad to have brief descriptions of cold weather construction methods where unusual conditions prevailed.

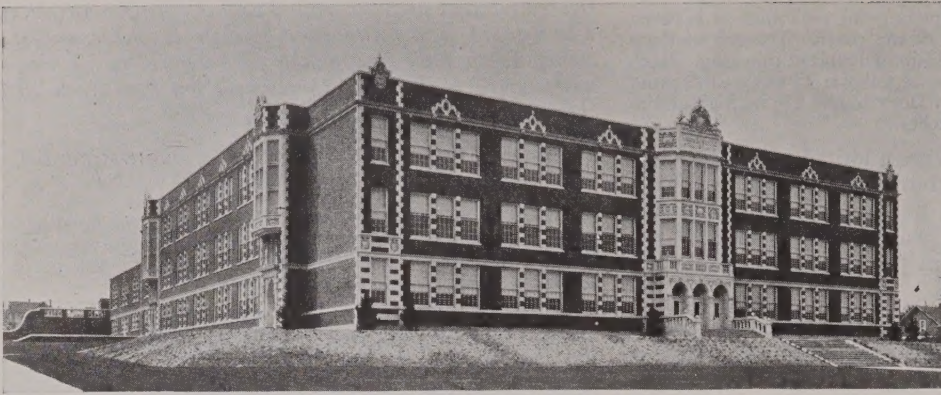


FIG. 1—THE JAMES A. GARFIELD HIGH SCHOOL SEATTLE, WASH.

Fireproof School Building Contains Novel Features

Garfield High School Combines Economy of Material and Ease of Construction

BY F. A. NARAMORE
ARCHITECT, SEATTLE

In preparing the architectural plans for the Garfield High School, Seattle, Wash., the structural design, which to a large extent affects the cost of school buildings, was carefully studied in connection with architectural, heating and other requirements in order to obtain a well balanced combination for a substantial building in which every consideration was given to the economic use of material and ease of construction.

The building is of the skeleton type, with floor slabs, beams, columns and walls of reinforced concrete, all of which, including the roof, was first erected before the brick veneer and terra cotta trim were laid or any of the interior work was performed. Shelf angles, ties and other supports integral with the concrete were provided in the concrete construction, for the support and anchorage of the brick.

The exterior brickwork and terra cotta were then placed without interference from other trades. After the building was under roof, the interior work of erecting partitions, plastering, heating, plumbing, etc., proceeded without the confusions or delays which are so often present in the construction of a masonry type of building.

GENERAL DESCRIPTION

The Garfield High School is between 23rd and 24th Avenues and East Jefferson and Alder Sts. on a site about 340 ft. east and west by 615 ft. north and south. The building faces the north and has its longest dimensions north and south so that the maximum number of class rooms could be properly orientated to receive east or west light.

The size of the building on the ground is 198 ft. x 351 ft. To avoid excessive stair climbing, the building proper was planned with three floors, the first being only slightly above the ground. The rear portion containing the manual training shops, boiler room, gymnasium, and dressing rooms, botany laboratory, lunchroom and some class rooms, is two stories high.

The framework, floors and roof are built of reinforced concrete. All interior partitions are hollow tile, the

building being fireproof throughout. The boiler room is located at the rear and with coal bunkers so placed that coal can be delivered from above and fed into the fire boxes by means of gravity and automatic stokers.

Two water tube boilers supply steam for operating the heating system; the split system of heating and ventilation was adopted, and the fans so placed and arranged that the assembly hall and gymnasiums can be ventilated independently of each other or of the rest of the building, thus insuring economy of operation. The main steam and pumping pipes, electrical conduits, and main ventilating ducts are carried in tunnels underneath the first floor, thus making them easily accessible for repairs or replacement and at the same time avoiding an expensive and complicated system of overhead piping and ducts in the ceilings of the stories above.

A freight elevator running the full height of the building is designed to transfer supplies and heavy articles to any floor. All rooms are provided with electric lights, and the fixtures are of a semi-direct design that give efficient illumination.

The exterior is Jacobean in style with red face brick and light gray terra-cotta trimmings. Such architectural embellishments as are used have been placed at the entrances and stair halls, the intent being to obtain a pleasing and dignified appearance without excessive cost in either irregular or odd-shaped plan or over-construction of ornament.

After orientation, the circulation or arrangement of halls and corridors is the next important consideration in school planning. In the Garfield School this has been attained by placing the assembly hall and stage, general locker room, gymnasium and cafeteria in the center of the building, running the corridors around this nucleus and surrounding the corridors with class rooms facing the outside. In this way, the best lighting conditions are obtained for the principal rooms of instruction while those devoted to purposes where less natural light is required are placed in the center of the building.

CONCRETE

Four main stairways with connecting entrances are placed at the four corners of the main corridors and thus provide ample floor communication and exit facilities.

A fireproof moving picture machine booth at the rear of the balcony provides ample facilities for illustrated lectures and the showing of educational films. The laboratories are grouped together on one floor with common stock rooms so that apparatus may be easily interchanged. This scheme of correlation of departments and rooms has been carried out through the entire building and rooms with similar or closely allied work such as commercial science, art, domestic arts, etc. are grouped together.

There are two gymnasiums on the second floor, one for boys and one for girls. These rooms are adjacent and can be thrown together for special purposes by means of large rolling doors or partitions. There is a running track in the boys gymnasium which can be used as a balcony during athletic contests. The gymnasium dressing and shower rooms are situated on the

first floor and are directly connected with the gymnasiums by independent stairs. This whole department has been planned so that it is accessible from the outside without passing through the rest of the building.

The cafeteria is directly back of the stage, is lighted from the light courts, and thoroughly ventilated. It accomodates 350 students in each shift.

The building contains 27 class rooms, 6 science laboratories, 4 commercial rooms, one cooking room, 2 sewing rooms, one art room one mechanical drawing room, a music room, a study room, library, two gymnasiums, a cafeteria, an assembly hall and stage and the necessary accessory and administration rooms. It has been carefully planned and designed to fulfill modern educational requirements and standards. It has been built with an idea of permanency and long service and still retaining a flexibility which will permit changing various rooms to accommodate possible changes in educational requirements.

CONSTRUCTION FEATURES

The formwork throughout consisted of 1 in. x 6 in.

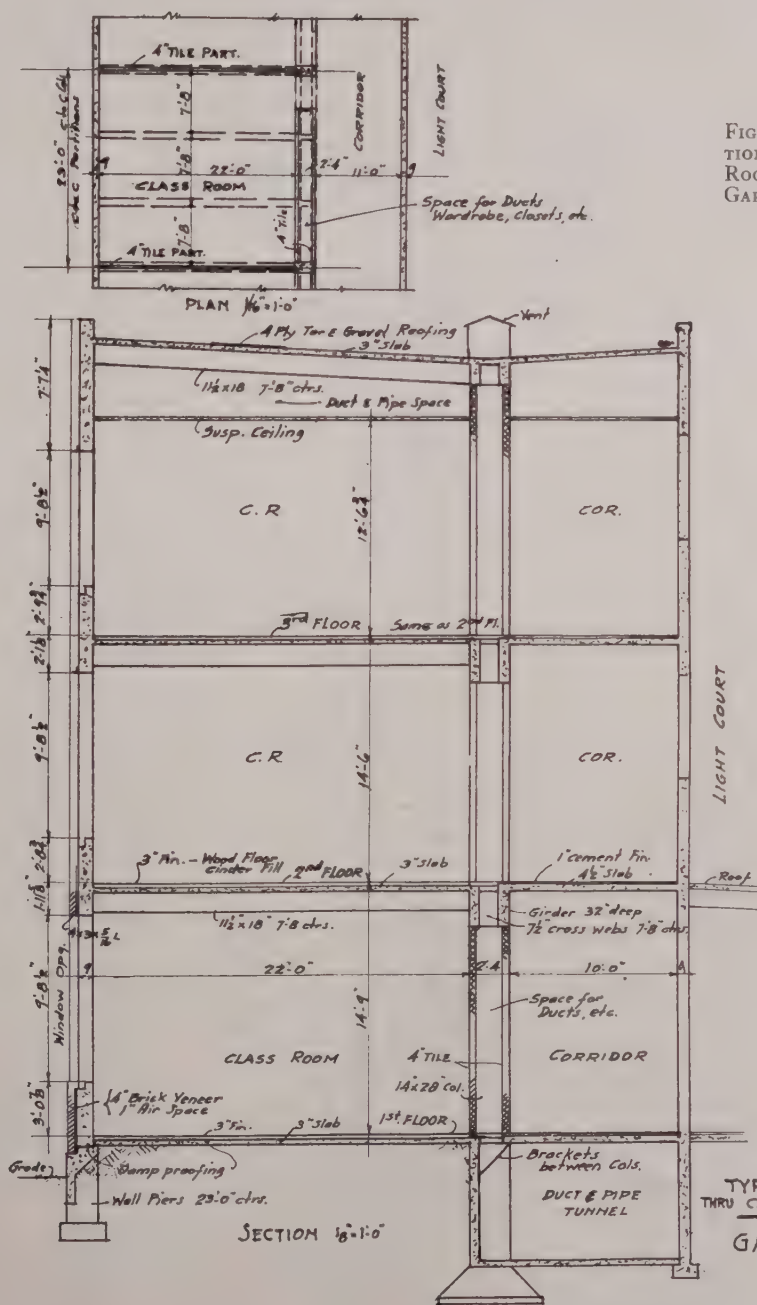
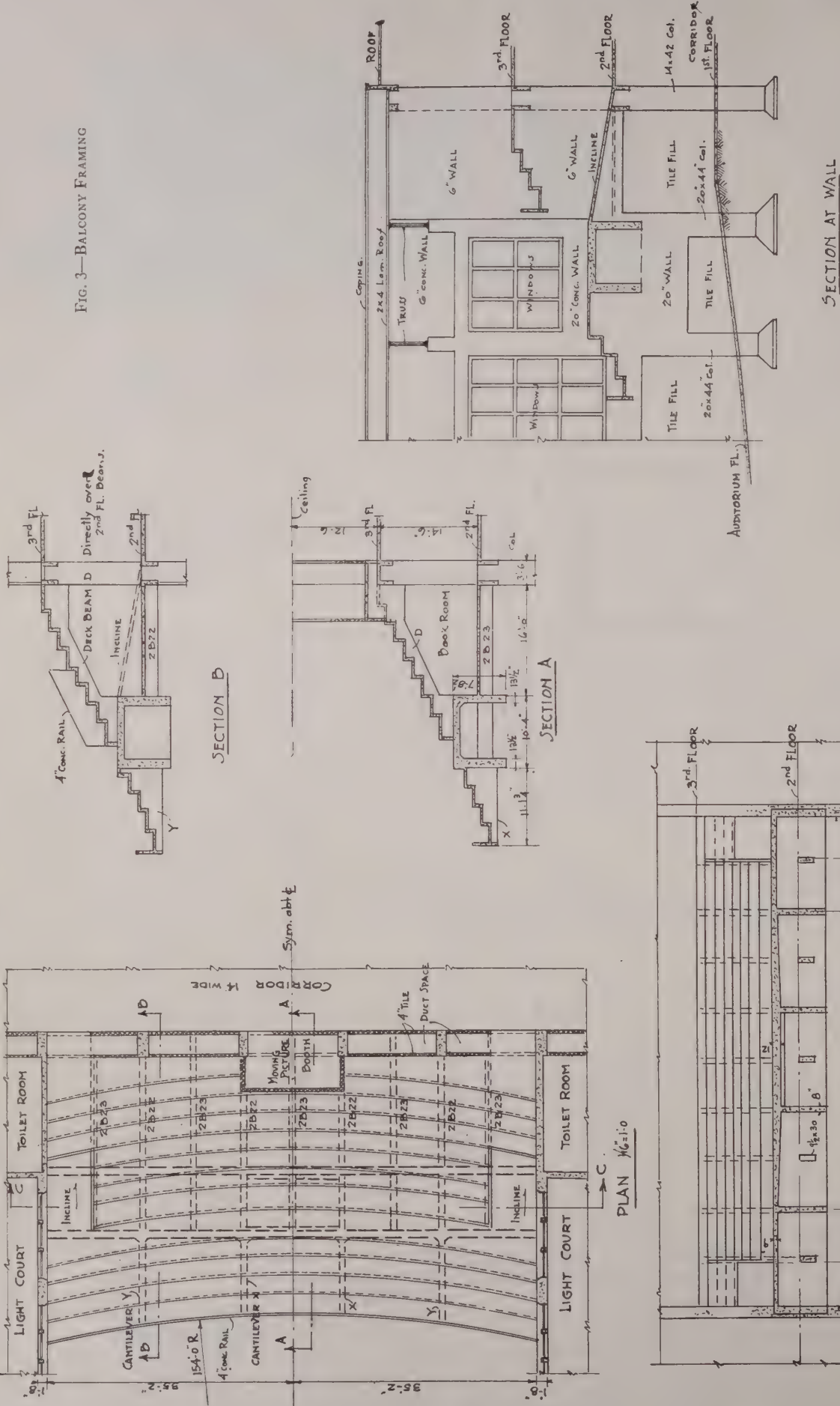


FIG. 2—TYPICAL SECTION THROUGH CLASS ROOM AND CORRIDOR, GARFIELD HIGH SCHOOL

FIG. 3—BALCONY FRAMING



CONCRETE

and 8 in. shiplap, 2 in. plank for beam bottoms and columns and 2 x 4's and 4 x 4's for centering. The forms were designed to be used a second time, but in many places it was found uneconomical to spend much time in removing and cleaning them and most of the shiplap was discarded after stripping.

The concrete was prepared in a two-sack mixer, centrally located, discharged into buggies and hoisted up to the floor levels in the ordinary type of construction elevator, and from there wheeled to place and emptied. Incidentally, the wheeling operation had the undesirable tendency to settle the coarser contents of the buggies, especially in distances that exceed about 200 ft. so that on long hauls the concrete was stirred up in the buggies before pouring. The concreting crew, including the men at the mixer and hoist, consisted of 20 men and one foreman. The average pour was about 60 to 90 cu. yds. per eight-hour day.

Inspection, both field and shop, of materials entering into the rough construction and finishing was given unusual attention and an inspector was present at all times during construction to insure good workmanship.

CONCRETE

The quality of cement, sand and gravel available for building purposes in the Seattle District is exceptionally good, and due to the uniformly high strength obtained in tests, a concrete working stress somewhat higher than is usually employed elsewhere was used. The grading of the aggregates was regulated to keep the fineness modulus at about 5.7 and mechanical analysis of the materials was made at frequent intervals and the proportions 1:2:4 were slightly varied to suit.

Test cylinders, 8 in. x 12 in., were made during the pouring operations. The number of samples taken depended upon the importance of the work, usually 6 to 9 cylinders per floor, and a total of 34 cylinders were tested for the entire building. They averaged about 2900 lbs. per sq. in. at 28 days, the lowest failing at 1650 lbs. and the highest at 3788 lbs. Cylinders that were made from the balcony concrete and held for 6 months tested 5200 lbs. per sq. in.

In order to obtain the highest possible strength of workable concrete, a fairly dry mix was necessary, 6-to 7-in. slump, and unusual precautions were taken to thoroughly work the material around the steel and to completely fill the forms. The handling of stiff concrete that would not flow like "soup" was not greatly favored by the man with the spade and if he was not continually watched, laxity in placing the material resulted. To avoid pockets and exposed gravel in dry run concrete required exceptionally conscientious and experienced men in placing and tamping the material in forms that were tight and thoroughly water-soaked.

STRUCTURAL DESIGN DATA USED

Stresses Concrete (1:2:4) approximately to test 2500 lbs. per sq. in. in 28 days.	
Flexural stress, comp.....	$f_c = 850$
Direct comp.....	$f = 560$
Shear, no stirrups.....	$f = 60$
Shear with stirrups.....	$f = 120$ (240 maximum allowed by code for thoroughly reinforced beams)
Reinforcing steel, (deformed) high carbon.....	$f_s = 20,000$
Ratio moduli of elasticity.....	$n = 12$
Line Loads—Pounds per sq. ft.	
Class rooms, fixed seats.....	50
Corridors and stairs.....	75
Roof.....	25
Wind.....	20
Gymnasium.....	100
Running track in gymnasium.....	125
Manual training shop.....	125
Balcony, in auditorium.....	75
Grid-iron over stage.....	40
Fly gallery.....	50
Foundations—Soil bearing value,	
Exterior walls and columns.....	7,000 lbs. per sq. ft.
Interior walls and columns.....	8,000 lbs. per sq. ft.

All factors affecting the strength of reinforced concrete were taken advantage of, including the full compressive value of the stem of T-beams, i. e., area between the bottom of the slab and the neutral axis, and re-

strained beam action, together with the high tensile strength of high carbon deformed reinforcing steel. Since the building was to receive its full live load about a year after the concrete was poured, the increased strength of concrete due to aging was given consideration in deciding upon the high stress value, $f_c = 850$.

LIVE LOAD REDUCTIONS

The total live load carried by the floor beams and girders was reduced from 10 to 15%, depending upon the contributory area supported. Column live load reductions were also made, i. e., 5% reduction for the second story column, 10% of the total load carried for the first story columns, and 15% for the columns below the first floor. No live load reduction was made on the balcony.

The building code of the City of Seattle allows two classes of concrete construction, one of high strength requiring skilled design and construction methods, and the other permitting a lower strength in which more freedom in design and workmanship is tolerated. The former, known as Class A concrete, is more satisfactory and economical for large work. The Garfield High School comes under this classification.

The unit working stress of Class A concrete is based on 90% of the 28 day ultimate strength of the concrete used on the job and as determined from test cylinders so that it permits the designer and the constructor, together, to take full advantage of their skill in the art of concrete construction. For a 2500-lb. concrete, the value of f_c in bending ($.375 f_c$) is $2500 \times .9 \times .375 = 845$ lbs. per sq. in. In Class B concrete, f_c is not to exceed 650 lbs. per sq. in. for 1:2:4 mix.

The building code has recently been revised, however, and since January 1, 1924 the maximum value of f_c is 750 lbs. per sq. in. for 1:2:4 concrete poured under expert supervision and 560 lbs. per sq. in. for the same mix for Class B construction.

Also, live loads for school corridors were increased to 100 lbs. per sq. in.

The code, in detail, conforms in many respects to the rulings recommended by the Joint Committee and others regarding reinforced concrete.

The city requires that all Class A work be rigidly inspected and supervised as to quality of materials and field operations and the work includes sieve analysis of the aggregates, proportioning, methods of mixing, placing of steel reinforcement and the testing of cement, concrete cylinders and steel reinforcing. Reports of all tests and field records relative to the work must be filed with the building department.

The Garfield High School building has a normal capacity of 1,380 students, is 216 ft. x 239 ft. in plan and three stories high in the class room portion. It is provided with an auditorium and stage, separate gymnasiums for boys and girls, manual training shop, science and botany rooms, etc., making the school modern in all respects.

Heating and ventilating is accomplished by the "split" system, using steam radiation and fans. There are two fan rooms located under ground, one on each side of the stage. The boiler room, containing two horizontal tubular boilers of 240 h. p. each and equipped with automatic stokers, is situated in the rear of the building and below the lower or ground floor. Provision also has been made for using fuel oil instead of coal for fuel.

A unique feature in connection with the boiler room is the arrangement of the inclined columns supporting the wall end of the floor above and which also form the front inclined beams of the coal bunkers. This manner of framing results in only one column in the boiler room, which is 43 ft. x 58 ft. in size. The bunkers have a total capacity of 90 tons.

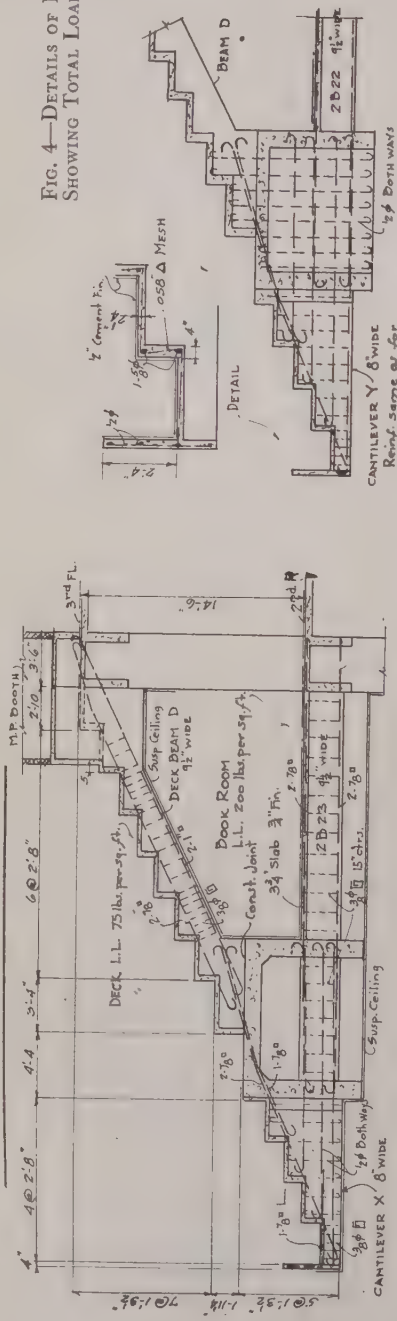
From the boiler room and connecting the fan rooms and other parts of the building are large under-ground tunnels containing the piping (steam, water, drain and electric) and ducts for the rooms above and sufficient working space for inspection and repair.

Fig. 2 shows the typical class room and corridor layout. The fresh air ducts and piping in the tunnel below the first floor enter the space between the tile walls and rise up and out to the various rooms. The space also provides passage way for the foul air to be expelled through the ventilators on the roof.

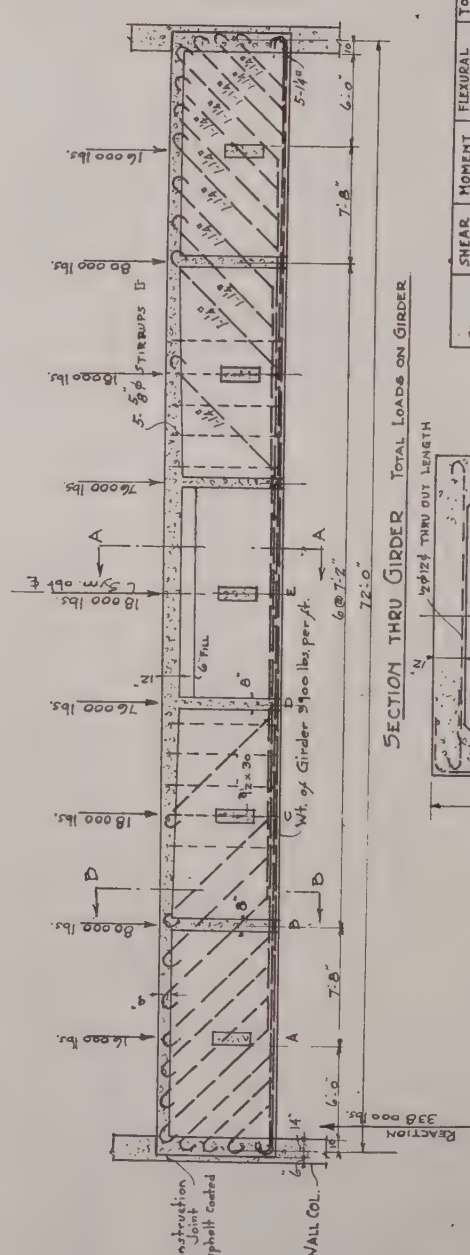
This method of treatment results in the use of double stemmed girders, supporting the floor construction, the middle flange of which is omitted where ducts pass through. The width of the girders is 28 in., with 6½-in. stems, giving a clear space between of 15 in. for a 12-in. duct. On account of the narrow stem width, extra care was exercised in placing the concrete in this important part of the framing.

The class room floor construction, in general, consists of a 3-in. reinforced concrete slab with 11½-in. x 18-in. T-beams, 7 ft. 8 in. on centers, 28-in. x

FIG. 4—DETAILS OF BALCONY FRAMING, SHOWING TOTAL LOAD ON GIRDER



SECTION D



STATION	SHEAR 1000 lbs.	MOMENT 1000 ft. lbs.	FLEXURAL STRESS lbs. per sq. in.	TOTAL SHEAR lbs. per sq. in.	BOND lbs. per sq. in.
E+1	336	—	—	136	84
A	311	2292	285	143	77
B	267	187	260	125	38
C	159	141	260	76	14
D	113	37	275	54	9
E-1	9	6608	765	4	—

DETAILS OF BALCONY FRAMING. GARFIELD HIGH SCHOOL

CONCRETE 1-2-4 MIX APPROX. REINF. STEEL HIGH CARBON, DETROIT.

FIG. 5—BALCONY FORM
READY FOR POURING
CONCRETE

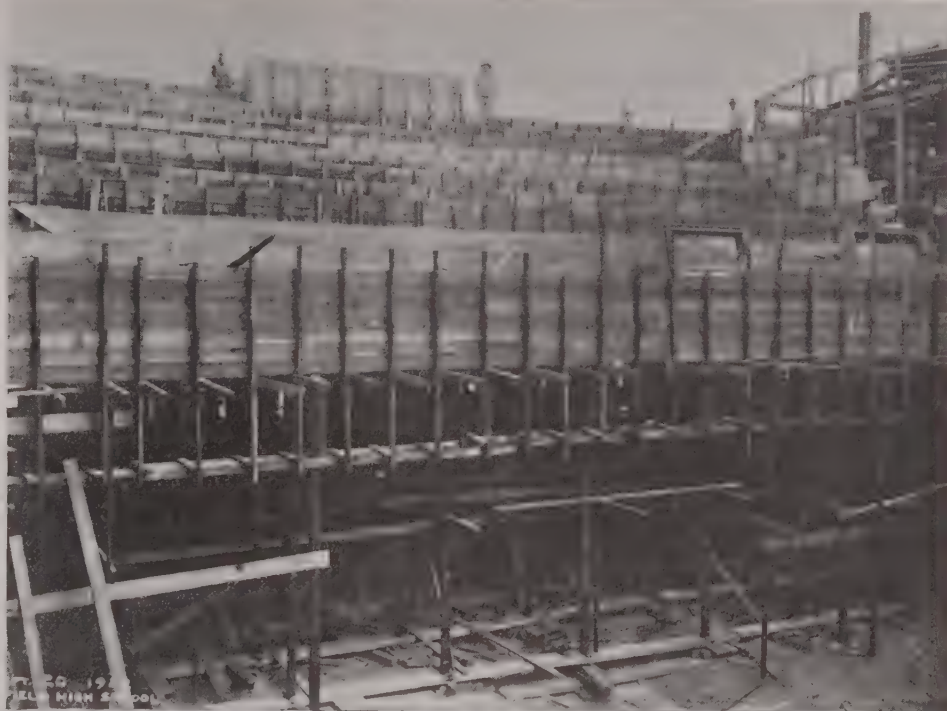


FIG. 6—UNDERSIDE OF
BALCONY WITH FORMS
STRIPPED



32-in. double stemmed girders and 14-in. x 28-in. columns. The exterior walls of the building are of 9-in. concrete with $\frac{1}{2}$ -in. round bars 18 in. centers both ways. The outside of the walls, except in light courts, are veneered with 4 in. of brick set 1 in. away from the concrete. The inside is finished with plaster direct against the concrete, and dampproofing is applied on exterior face of concrete where brick veneer is used.

The pipe tunnels, varying in height from 6 to 10 ft. have walls 6 in. thick and reinforced with $\frac{1}{2}$ -in. rods.

The roof slab of 3-in. concrete is supported by 11 $\frac{1}{2}$ -in. x 18-in. beams sloped with the roof and from which, a few feet below, is hung the suspended ceiling of metal lath and plaster. The space between roof and ceiling furnish access to ducts and piping. By canting the roof beams to follow the slope of the roof a considerable saving in cinder fill was effected and much dead weight eliminated.

BALCONY FRAMING

The auditorium of the building, approximately 72 ft. wide and 85 ft. long, has a seating capacity of 1,250 of which 400 persons may be accommodated on the balcony. This balcony is one of the interesting structural features of the building. It is entirely of reinforced concrete, and has a clear span of 70 ft. 4 in. as shown in Figs. 3 and 4.

The large double stemmed girder of the balcony is 10 ft. 4 in. wide and 7 ft. 8 $\frac{1}{2}$ -in. deep with stems 13 $\frac{1}{2}$ in. wide. It supports the overhanging portion of the balcony and about one-half of the upper part. The other half of the upper part is carried by the girders and columns of the second and third floors.

The top flange of the girder is 12 in. thick at the middle and tapers to 9 in. at the supports. The stems are stiffened at intervals of about 14 ft. x 8-in. solid cross webs and at intermediate points by 9 $\frac{1}{2}$ -in. x

30-in. beams. The cantilevers and deck beams supporting the $2\frac{1}{4}$ -in. deck slab and 4-in. joists are framed into the girder at these points. The ends of the girder are closed up with a solid web, 14 in. thick, which furnishes ample bearing surface at the supporting columns, or abutments.

In addition to its own live load, the balcony supports the load brought in from the book stock room, 200 lbs. per sq. ft., at the second floor level, part of the weight of the motion picture booth at the upper end, and the weight of the suspended ceiling on the under side of the balcony.

Entrance to the lower portion of the balcony is afforded by two inclined passages from the second floor level. The roof of the auditorium, consisting of laminated 2×4 's covered with asphalt and gravel roofing, is supported by 72-ft. steel trusses which are concealed by a suspended ceiling of metal lath and plaster. To the ceiling of the auditorium was applied an acoustical treatment of hair felt and cloth.

Fig. 3 shows the general arrangement of the balcony portion of auditorium together with the framing and wall support. The overturning tendency produced by the overhanging portion of the balcony is well counteracted by the joint dead weight of the construction above the girder and that of the second floor.

The deck slab, of $2\frac{1}{4}$ -in. net thickness, is supported on the inclined deck beams and cantilevers, X and Y as shown in detail in Fig. 4. The total loads carried by the girder are assumed concentrated at the points indicated and are considered equally distributed to both stems of the girder by means of the solid cross webs and the beams, 2B22 and 2B23.

The girder was computed as a simple beam resting in a pocket 14 in. deep, at each supporting column. Because of the relative stiffness of the girder and the slender column, 20 in. thick and 10 ft. 4 in. wide, which also carries a roof truss above, fixed end condition at the column juncture was avoided by coating the pockets with asphalt.

In pouring the balcony, all the concrete, including the second floor portion, was poured up to the top of the girder in one continuous operation, and the upper portion completed on the next day.

The concrete mix is 1:2:4 throughout with the exception of the concrete in the bottom of the girder stems, which was made 1:2:3 to insure better bond for the heavy reinforcement. The girder seats in the columns were also made of the same mix. For anchoring the girder to the columns, short $1\frac{1}{8}$ in. round dowels were provided in the girder seats. The balcony contains two 4-ft. aisles of steps $7\frac{3}{4}$ in. high formed by adding an intermediate concrete step to the joists of the balcony after the decking was poured.

COST DATA

The cost data on the building is as follows:

General (including the improvement of grounds).....	\$453,000	
Heating.....	102,021	
Plumbing.....	39,205	
Electrical.....	21,000	
Clocks.....	5,273	
Elevator.....	3,294	
Total Building.....		\$623,793
Total Mechanical.....	\$170,793	
Per Cent General.....	37.7	
Mechanical Percentage of Building.....	27.4	
Electric Light Fixtures.....	4,237	
Window Shades.....	3,095	
Fixtures, Furniture and Equipment (Everything necessary to furnish the building ready for the pupils to move in with the exception of books and supplies).....	90,000	
Architectural and Engineering Services.....	35,000	
		132,332
Total Cost of Building.....	\$756,125	
Cubic Feet.....	2,543,000	
Square Feet of Floors, measured to the outside of walls.....	128,000	
Normal student capacity of the building.....	1,380	

This is 80% of the total seating capacity, not including the assembly hall.

The general contract, amounting to about \$453,000, was let April 10, 1922. The structural features required



FIG. 7—REAR VIEW OF BALCONY GIRDER

FIG. 8—N. E. CORNER OF BUILDING WITH FORMS IN PLACE FOR CONCRETE SKELETON

the placing of approximately 7,000 cu. yds. of concrete, 490,000 sq. ft. of forms and 290 tons of steel reinforcing. Structural steel for trusses, shelf angles, etc., amounted to 30 tons. The formwork, including posts and braces, required approximately 800,000 ft. b. m. of lumber.

The pouring of footings was commenced May 29, 1922, and the concrete work of the building was finished December 2, 1922. Brickwork was started in November, and the plastering and general interior finishing work was begun in January, 1923. The building was completed in time for the opening of the school year, September 3, 1923. A total of 16 months was required to perform the work.

The structural design was executed in the office of the Architect F. A. Naramore by Homer M. Hadley and H. C. Witte, and the field inspection of the concrete construction work was done under the same direction by D. A. Christianson. Dugan and Chrisman of Seattle and Portland were the general contractors.

Is there a particularly skillful man in your organization?
What does he do and how?

Building Strengthened *Beams Built Up With Gunite*

An interesting use of gunite in strengthening a reinforced concrete floor system was recently made in connection with work in the rear of the Heard building, Phoenix, Arizona. New reinforcing was placed on the exterior of existing beams and girders and all the sides were built up with gunite.

The old concrete floor system was overloaded to such an extent that bad cracks had developed in the beams and girders. In preparing the members to receive the gunite, the old plastering was removed and enough bush-hammering done to expose not less than 50% of the old concrete. This percentage, it was figured, would be sufficient to insure a satisfactory bond between the old and new concrete.

Shear was taken care of by drilling holes through the floor and slipping vertical "U" bars over the beams. The floor slab was strengthened by shooting an arch from beam to beam as shown in the accompanying illustrations. As there was a wood floor over the concrete, the shear bars were merely grouted at the top to prevent rusting.

Before applying the gunite, the beams and girders were blocked up with a view to moving the initial stress so that the old and new steel would be working under the same stress conditions under load. This was considered one of the delicate problems and some difference of opinion arose as to the practicability of this method. The success of the method, however, is evident from the fact that the floor has been loaded up to maximum and there was every indication that the job was a perfect one.

An alternate method was figured on for strengthening the floors. This proposed method included the application of reinforcing on the bottom of the floor slab and shooting on a layer of gunite to strengthen the floor. The arch arrangements worked out very satisfactorily

FIG. 1—INTERIOR VIEW SHOWING UNDERSIDE OF SLAB AND BEAM AS PREPARED TO RECEIVE THE GUNITE. THE UNDERSIDE OF THE FLOOR SLAB WAS BUSH-HAMMERED TO PROVIDE A SURFACE FOR THE GUNITE

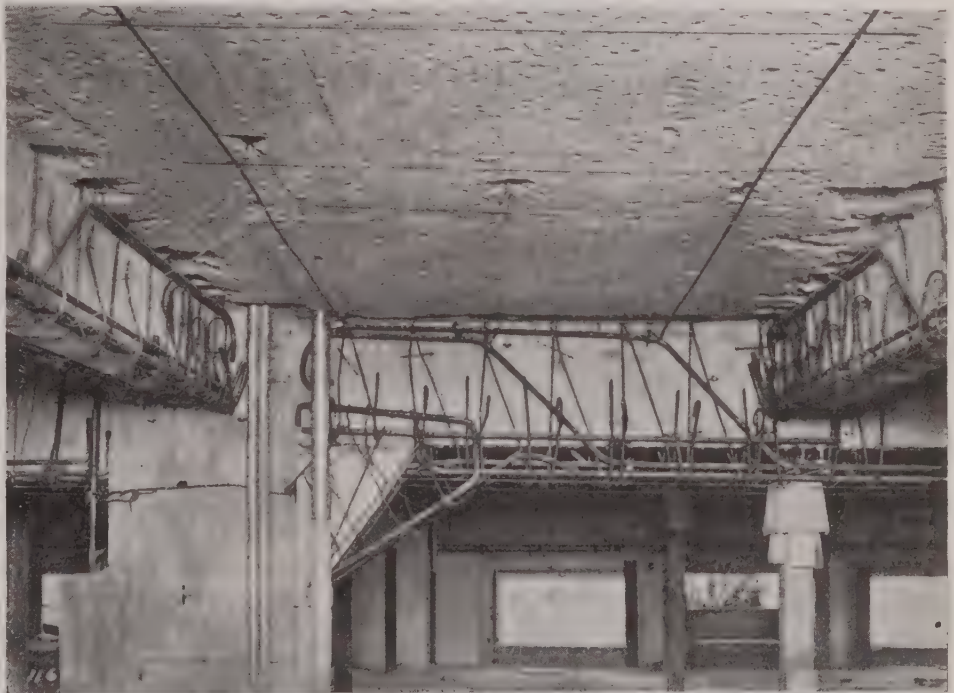


FIG. 2—UNDERSIDE OF THE FLOOR SHOWING THE APPEARANCE AFTER THE GUNITE WAS FINISHED



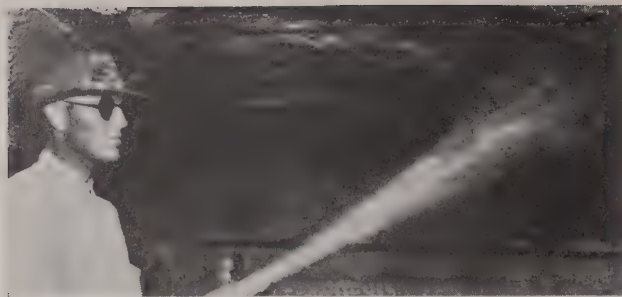


FIG. 3—SHOOTING GUNITE TO BUILD UP THE ARCH SECTION FROM BEAM TO BEAM

in this particular case. If the span had been excessive it would have been necessary to resort to the other method.

The loading on the original floor was figured as 60 lbs. per sq. ft. live load. The live load on the rebuilt gunite floor was figured at 200 lbs. per sq. ft. and the building is now loaded to that extent. The Los Angeles Cement Gun Co. by whom the gunite work was done, suggested the application of a test load to the floor, testing it to a point where the deflection would be noticeable. Half of the cost of the test was to be paid by the Los Angeles Cement Gun Co. but the owners felt that this test was unnecessary.

The experience of J. C. Hain, manager of the Los Angeles Cement Gun Co., to whom CONCRETE is indebted for the above information, lead to the conclusion that round bars are better than any other shape to shoot gunite around, and it is also advantageous to use small bars in preference to large ones. Half-inch bars proved better than larger bars.

Chapel Has Concrete Dome and Stucco Interior

An interesting memorial chapel with a white concrete dome and a portland cement stucco interior finish which has just been completed at Mt. Hope, N. Y., holds quite a little interest for the architect, the engineer, and the builder in concrete.

The building, which is shown in Fig. 1, stands on a grass-covered hillside in the Westchester Hills Cemetery, a gift to the Free Synagogue of New York from Benjamin Block of New York as a memorial to his wife, in whose memory it is named the "Birdie Block Memorial Chapel." Situated on one of the main roads leading from New York City, its unusual architecture and striking white dome make it a conspicuous landmark.

Architecturally, the designer traces the inspiration for the structure to one of the few surviving structures of antiquity to which Israel can lay claim. Partly because of the racial sentiment attached thereto and partly because of the eternal fitness of the original, the design

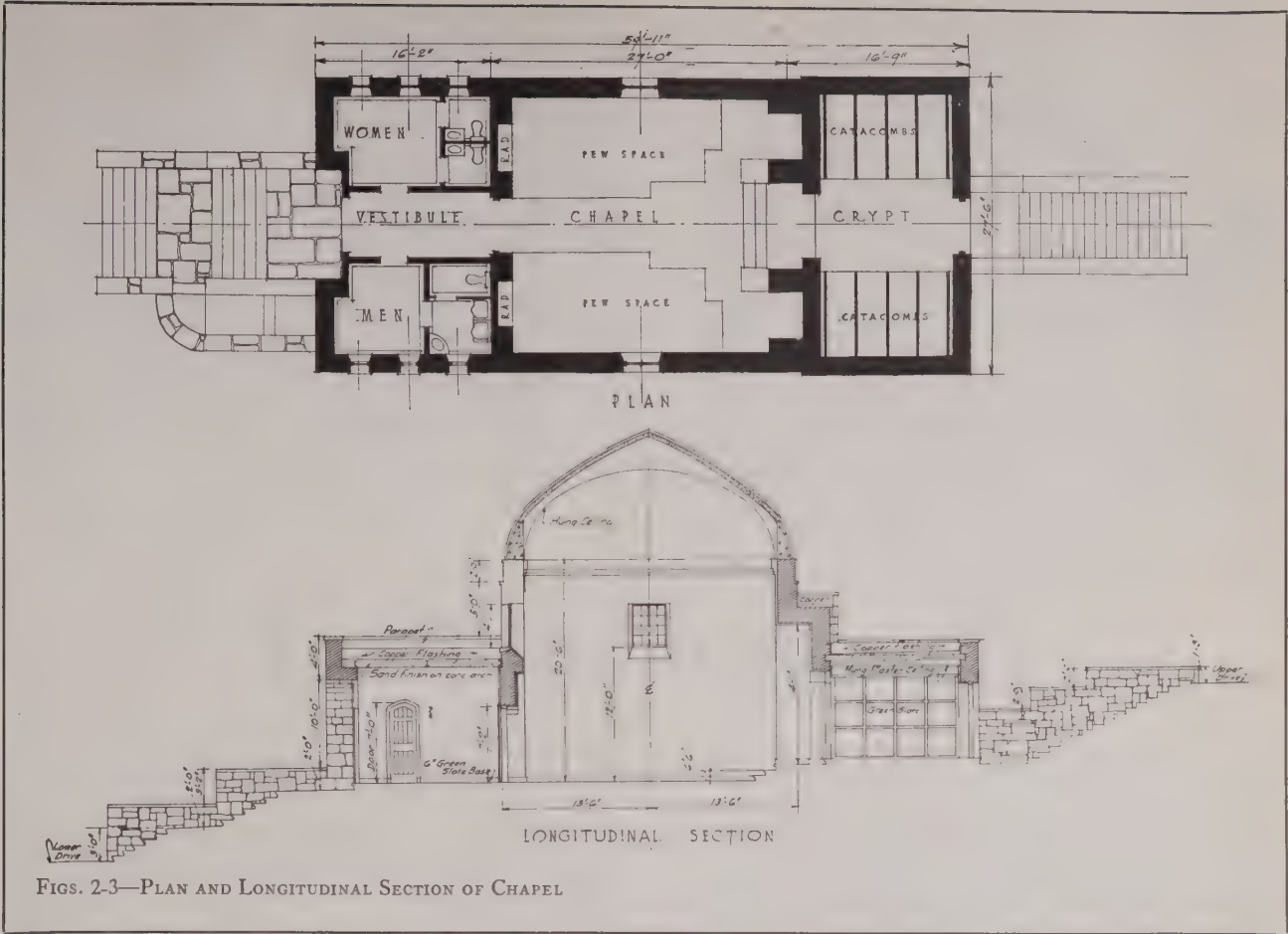
has been based on the "Tomb of Rachel" which still stands today on the road between Bethlehem and Jerusalem.

The building consists essentially of a chapel and a crypt. The floor plan is shown in the sketch in Fig. 2. As will be seen, the building is approached from the road by a flight of steps, leading to the entrance door. Inside the entrance door is a short corridor opening into the chapel proper. On each side of the corridor is a rest room with the most modern type of plumbing fixtures, tiled floor and wainscot, etc. Hope steel casement windows are installed.

The chapel itself is practically 23 ft. square and seats 90 persons in pews. A raised dais in a deep arch in the chapel wall takes the place of an altar. From the dais large double doors open into the crypt in which catacombs for twenty-four dead have been provided. The catacombs are built of heavy slabs of green Vermont marble. At the opposite end from the chapel the crypt

FIG. 1—MEMORIAL CHAPEL WITH CONCRETE DOME, BUILT ON HILLSIDE





FIGS. 2-3—PLAN AND LONGITUDINAL SECTION OF CHAPEL

opens onto a long flight of steps in the rear of the building, leading up to the driveway, from which all parts of the cemetery may be reached. A vertical section through the building is shown in Fig. 3. The small cellar in which is located the Arcola steam heating plant and the hot water heater for the rest rooms is omitted. The cellar is reached by a short flight of steps shown at one side of the main entrance steps in the floor plan.

The main body of the building is constructed of heavy quarry faced field stone. The masonry opening spanning the entrance door is "beehive" in shape to conform to the rugged simplicity of the general design. The doors themselves are of solid oak, simple and massive in line, and modelled after the doors on Jaina Temple, Boroda State, India. Heavy horizontal and vertical battens are carved into conventional patterns, and the doors stained and lightly touched with color.

Floors generally are of cement, marked off into irregular rectangles, somewhat after the fashion of random sized slate. The interior of the chapel proper, the entrance corridor, and the two rest rooms are all finished in a very light—almost white—portland cement stucco with an irregular textural finish. Fig. 4, which is a photograph of the interior of the chapel, shows the fine restraint of the architectural design, as well as the interesting surface texture in the stucco.

To the engineer and the concrete worker, however, the dome is probably the most interesting part of the structure. While the dome was designed for structural steel and wire lath with cement plaster the contractor suggested the advisability of a change to reinforced concrete in the interest of ease of construction and economy.

Fig. 5 is a section through the dome, showing the principal constructural details. The structural dome



FIG. 4—VIEW OF INTERIOR, SHOWING SURFACE TEXTURE OF STUCCO

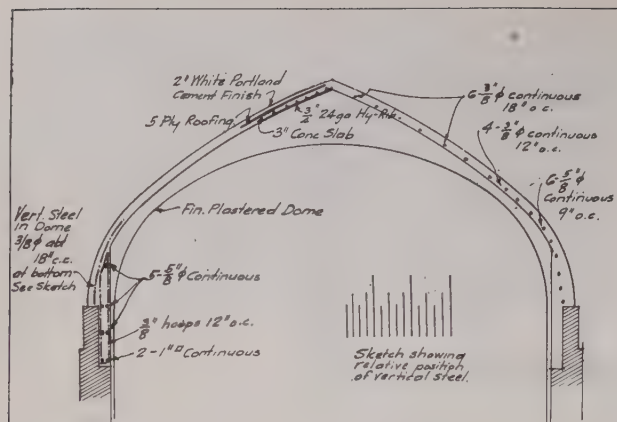


FIG. 5—SECTION THROUGH DOME, SHOWING SOME OF THE STRUCTURAL DETAILS

is of 1:2:4 concrete 3 in. thick on combined forms and reinforcing built up of $\frac{3}{4}$ -in. 24 gauge "Hy-rib," with certain additional reinforcement at the base of the dome and for temperature stresses. The Hy-rib was supported by skeleton centering to avoid unsupported spans of longer than 3 ft.

Over the structural concrete was applied a 5-ply tar and felt membrane waterproofing. A hung ceiling of metal lath forms the inner surface of the dome as seen from the chapel. Over the waterproofing a finish coat of $2\frac{1}{2}$ in. of white portland cement concrete with integral waterproofing is applied for architectural effect.

The building was designed by Walter Haefeli, architect, of New York. The concrete work for the structure was done by R. Jenkins of Yonkers, N. Y., sub-contractor, the general contract being handled by G. Richard Davis Co., of New York and White Plains.

Concrete in Sea Water

Some important conclusions as to the effect of sea water on concrete, based upon the results of tests of specimens of concrete placed in St. John's Harbor, are given by A. G. Tapley, assistant engineer, Department of Public Works, Canada, in a paper read before the St. John branch of the Engineering Institute of Canada, and reprinted in the *Engineering Journal*. The tests specimens included one 10-ft. length of concrete pipe furnished for testing purposes by the Lock Joint Pipe Co., East Orange, N. J.; 18 concrete cylinders, 6 in. x 12 in., received from the laboratory for testing materials, Department of Public Works, Ottawa, and additional test specimens approximately 6 ft. long by 12 in. x 14 in. Careful notes were made as to the tests of the aggregate, analyses of the cement and of the mixing water used. Analyses were also made of samples of sea water from St. John's Harbor where the experiments were carried on.

The following general remarks and conclusions are excerpts from Mr. Tapley's paper:

GENERAL REMARKS

It is the writer's opinion that, in northern waters, the main damage to concrete in sea water is caused by mechanical action, through freezing and otherwise, rather than chemical action. In the study of our specimens, it has been observed that during the summer months disintegration is not discernible, while in the winter months it is very rapid.

No doubt a certain amount of chemical action occurs mainly through the sulfates and carbon dioxide, but I am of the opinion that the lower temperatures of the sea water in northern latitudes has a tendency to greatly retard this action, while the warmer temperature of those latitudes where frost does not occur accelerates chemical action.

It has lately been demonstrated that if concrete be placed in a strong saline solution, and the solution then be heated to evaporation that salts will be deposited in the pores of the concrete. These salts then expand with results, to the concrete, similar to freezing action.

If we take a piece of concrete and partially immerse it in water, we shall find that the water runs up inside it to a higher level than outside; and the more hair-like the passages in the concrete, the higher the water will run. This is due to its capillarity. The rising of the water in the concrete has nothing whatever to do with the atmospheric pressure.

Even most carefully prepared from materials of the highest grade, concrete is not of itself completely waterproof. In large masses of actual work, it is difficult to produce concrete of such close texture as to prevent undesirable seepage at all points.

When through absorption and capillarity, the pores of the concrete become saturated with water and frost receives the opportunity to

act on this water, the result is very similar to that which occurs when a water pipe freezes. After each successive freezing, erosion occurs and the next freezing penetrates deeper into the concrete, until it is destroyed.

It is not only in sea water that damage occurs to concrete through freezing, as a number of structures on the Great Lakes have been so damaged, viz., at Port Arthur, Fort William, Sault Ste. Marie, and the concrete footings of the transmission towers of the Ontario Hydro-Electric Commission.

Also, some stones that are liable to be destroyed by the effects of frost on first being taken from the quarries, are no longer so after being exposed for some time to the air, having lost their quarry water through evaporation. This difference is very manifest between stone quarried in summer and that quarried in winter. It has frequently happened that stones of good quality have been entirely ruined by hard freezing immediately after being taken from the quarry; while if they are quarried during the warm season of the year, and have an opportunity to lose their quarry water by evaporation, prior to cold weather, they withstand freezing very well.

In fact, whether it be stone, wood, or concrete, if there are pores or other shallow places, where the water is confined and held in suspension, and then subjected to hard freezing, damage will inevitably result, whether these materials be immersed in sea water or otherwise.

Another point concerning concrete of which we must take cognizance is cracking. By reference to the table showing present condition of the specimens, we find that the Lock Joint Pipe Co.'s 12-in. pipe is cracking badly, also that the inside skin is breaking away all over. Going back to the immersing of this specimen, we find that the pipe contains no reinforcing; that this inside skin was $\frac{1}{8}$ in. in thickness, and showed numerous small cracks, which were only discernible by the application of water. We also find that of the specimens treated with the cement gun, the one without reinforcing is showing some small cracks in the faces. In both cases, the concrete was, originally, as dense as we can expect to make it.

In most of the 1920 specimens, the first sign of disintegration was the breaking up of the face into numerous small cracks.

It is now generally accepted that it is not possible entirely to prevent the contraction of portland cement concrete, due to a drop in temperature or loss of moisture. It is common knowledge that most materials expand when wetted or heated, and that they contract when cooled or dried. It is not, however, generally known that in the case of concrete, the changes in bulk are influenced to a far greater degree by moisture than by changes in temperature. Concrete, in fact, swells and shrinks when wetted or dried just the same as a piece of timber, although to a much less degree. Concrete, when thoroughly saturated, expands about as much as if its temperature had been raised 1000° F. and it will therefore be obvious that in order to minimize this expansion and contraction, the access of moisture to the concrete must be prevented.

Comparing the compressive strength of specimens A2 and B11, we find that a 10% mixture of powdered red metallic oxide, (commercial ochre), caused a loss in strength to B11 of about 9%. These specimens are made from the same cement and aggregates, of the same proportions and mixed under similar conditions. Comparing their physical condition, we find that, after being immersed for three winters, B11 shows no change, whereas A2 is going badly at the top.

Unfortunately, we have no 6-in. x 12-in. cylinders of the *B1* specimen, and therefore we are not able to compare it with the others. However, from visual observation, it has the appearance of ample strength, and compares very favorably with either of the others.

This would indicate that the use of proper admixtures, in the right proportions is beneficial more particularly in the checking of contraction and expansion in the concrete, caused either by frost, moisture or temperature. The use of the powdered red metallic oxide was found to nicely lubricate the mix. This would permit of the use of less water, and at the same time secure a suitable workability. Workability is the controlling factor in the handling of concrete. No effect in shrinkage of the concrete has been noticed from the use of admixtures.

The increased yield of concrete containing powdered admixtures is probably sufficient to offset the cost of the admixture. There would also be a saving in labor cost and greater assurance of uniformity in the finished product. The concrete made under the old accepted methods is so lacking in uniformity as to make its poorest quality subject to rapid attack from sea water, and therefore dangerous and expensive.

As to the amount of powdered admixtures to be used, this must be determined by testing for the strength of concrete desired. Every aggregate to be used must be analyzed, by either mortar-void or sieve analysis, so that the proper amount of stone, cement, sand and water may be determined to give the desired strength with a suitable plasticity or workability.

There are a number of these powdered admixtures which have been tried out and which undoubtedly are beneficial to the concrete and greatly lengthen the period of its permanency, especially when used in sea water. Some of these admixtures are patented preparations, others are not. A few may be mentioned which we know to be good, viz., celite, kaolin, hydrated lime, powdered red metallic oxide, and puddled clay. The improvement in workability, which is effected by these admixtures in the proper proportions, is about that which should be expected from a 20% increase in the cement content.

We now have immersed specimens ranging in compressive strength from 1,675 lbs. per sq. in. to 5,448 lbs. per sq. in. They also include specimens with and without admixtures, precast, ponded, and cast in place, these latter being immersed by the next tide after casting. As precasting and ponding is a very expensive proposition, it should not be adopted until cast-in-place work has been definitely proved unsuitable. We should experiment further with admixtures. While some that we have used have failed, we fully expected that they would. Had they not done so, there would be no problem to be solved.

In mass work in sea water, a concrete having a compressive strength of 3,000 lbs. to the sq. in. should be sufficient. In cast-in-place mass work, the bottom of the concrete should not be placed at a lower elevation in the tidal range than will permit of the concrete receiving its final set before being covered by the next tide.

Regarding chemical action in concrete in sea water, we have a way of ascertaining the amount of this in St. John's harbor. Berth 15 at West St. John was constructed during 1914. The gravel filling behind the concrete superstructure was placed shortly after the completion of the wall. As this gravel filling has protected the concrete from frost action, by stripping away the gravel at some points, the damage caused by chemical action could be readily ascertained.

As field tests are necessarily long time tests, it seems to me that results from freezing, thawing, expansion from moisture and temperature, chemical action, etc., could all be ascertained in the laboratory in a fraction of the time in which they may be obtained in the field.

CONCLUSIONS

Concrete should be proportioned by weight. In this way greater uniformity may be obtained. The minimum of water necessary to obtain a plastic or workable mix should be used. The cement content should be at least 1.8 U. S. barrels, or 677 lbs. of cement to the cubic yard of concrete.

Where subjected to abrasion, from floating ice, logs, etc., the concrete should be protected with a suitable sheathing. The concrete should be further protected with a waterproof sheathing, or an integral waterproofing powdered admixture.

The concrete should be reinforced with steel reinforcing in such a manner as to take care of stresses arising from expansion and contraction.

A careful analysis of all gravel, stone and sand should be made by the sieve or mortar-void method, so as to accurately determine the correct amount of each, as well as the amount of water to be used.

Cement to be used should be carefully analyzed, to determine its suitability for use.

Different methods of tamping the concrete should be investigated. The vibratory method is finding considerable favor.

The use of powdered admixtures, and cast-in-place concrete, subject to immersion in a short period after placing, should be more thoroughly investigated.

The writer is convinced that cast-in-place concrete, containing a powdered admixture and properly reinforced, may be made, which will endure for much longer periods than concrete in sea water has heretofore endured, and which will compare favorably from an

economical standpoint with other construction materials. Also that concrete so made may be efficiently and economically repaired by the use of the cement-gun, when necessary.

Construction joints and sharp corners should be eliminated where at all possible. Before using, the cement should be aerated or air-slaked to cool it, and thus reduce expansion in the concrete.

There are three things which we may do to ensure the maximum of immunity from cracks in concrete construction, viz:

(1) Use either an efficient waterproof sheathing or an integral cement waterproofing process, or both.

(2) Use only clean suitable aggregates and a cool cement, which in itself is not liable to expand or contract.

(3) Reinforce the concrete by evenly distributed steel in small sections, so placed as to take up any stress which might arise in the concrete, and thus prevent expansion and distribute the movement due to contraction.

In the disintegration of concrete in sea water, in northern latitudes, what occurs is as follows:

The water enters the pores in the concrete causing the concrete to expand to its limit. When the exterior water recedes, the water is held in the concrete. Frost then acts on this water in the concrete, causing still further expansion. The concrete is unable to withstand this final expansion, and breaks down. In St. John's harbor, as mentioned in a previous article, mid-tide specimens are completely immersed for four hours, partly immersed for two hours, and subjected to hard freezing in winter seasons for six hours out of every twelve.

Mobile Paver Speeds Sewer Construction

Construction work on the Clayton and Zimmerman sewer jobs in Milwaukee, Wis., has been successfully completed, an unusual feature being the use of pavers with extra long booms for handling the concrete and depositing it into the forms. The pavers were supplied by batch trucks operating from the central storage bins.

This project lying in the northwest section of Milwaukee, just outside of the city limits, consists of a large section of undeveloped land, known as Roosevelt Drive, which is being improved and a drainage system installed, and which will be divided into lots prior to annexation to the city and sale for residence purposes.

The work is in two sections. The main sewer is 3,200 ft. long, 8 ft. 10 in. high from the bottom to the top edge with an opening of 6 ft., and is 19 ft. 9 in. wide. It is a two-barrel, rectangular sewer, each section of which is 8 ft. 6 in. wide. The outside walls are one foot thick. The top slab is 18 in. thick, the bottom slab, 16 in. and the center wall 9 in. thick.

On account of the width of the work, which was well over 25 ft., and the length, the Clayton Construction Co., the contractors, decided to use a paver for the concrete work because of its easy mobility. A special boom 45 ft. long was attached to a 21E paver.¹ The contractor built a support, which was moved by a couple of men as the work progressed, to prop the boom at the outer end. This arrangement allowed ample room for reaching the farther side of the forms and at the same time permitted a safe distance of the paver from the edge of the cut.

A central proportioning plant, equipped with Butler bins² and a belt conveyor loader³ was built midway from each end of the job, making the maximum haul of the three trucks 1600 ft.

Work was started June 12 and completed about September 6. An average of 76 lin. ft. of sewer was completed each working day, comprising the use of 1100 bags of cement a day used in a 3-bag batch of

¹Koehring Machine Co., Milwaukee, Wis.

²Butler Mfg. Co., Kansas City, Mo.

³Barber Green Co., Aurora, Ill.



FIGS. 1 AND 2—PAVER WITH SPECIAL 45-FT. BOOM DEPOSITING CONCRETE FOR CLAYTON SEWER JOB, MILWAUKEE, WIS. FIG. 2 SHOWS THE CONCRETE BEING PLACED FOR THE BOTTOM SLAB OF THE SECTION. THE SUPPORT FOR THE OUTER END OF THE SPECIAL BOOM IS SHOWN IN BOTH FIGURES

1:2:4 concrete. This total required six cars of sand and stone.

Connecting with this main double section sewer is another single section round sewer, 6000 ft. long and with a diameter varying from $6\frac{1}{2}$ to 8 ft.

The George F. Zimmerman Construction Co., Milwaukee, used a new 13E paver¹ with standard boom 20 ft. long. This work was started August 1 and it is expected it will be completed by December.

The sewer is built on a concrete slab 12 in. thick on the sides and from 16 to 18 in. thick in the center. At one end the sewer is built in two sections $6\frac{1}{2}$ to 8 ft. in diameter to connect with the large main sewer. The remainder is built in a single section $6\frac{1}{2}$ to 7 ft. in diameter.

Due to the swampy nature of the ground and the large amount of water in the bottom of the ditch it was necessary to use an extremely dry batch. Four shovelfuls of hydrated lime were mixed with each batch



FIG. 3—PAVER IN USE PLACING CONCRETE ON ZIMMERMAN SEWER JOB

to give the concrete additional smoothness. Since the start of the work the paver has averaged well over 600 bags of cement per day, handling the exceptionally dry mix with ease and speed.

After the bottom concrete was placed the circular forms were inserted after which the concrete was poured. Forms were removed at the end of each day. Twenty men comprised the working crew.

The above information is based upon material furnished by the Koehring Machine Co.

Mixer Name Plates

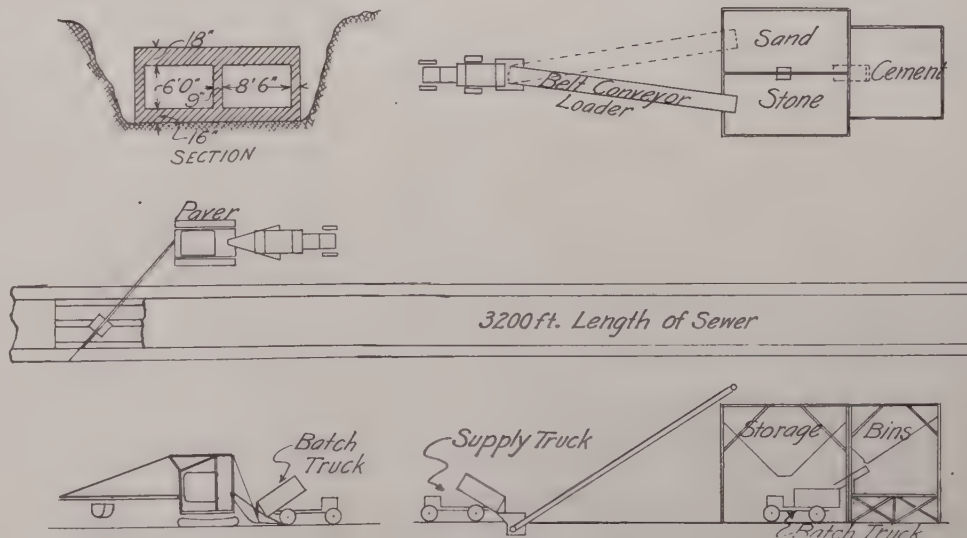
Members of the Mixer Manufacturers' Bureau of the Associated General Contractors have ordered to date more than 3,700 A. G. C. standard name-plates to be placed upon their products. The plates are now in process of manufacture and should begin to put in their appearance on mixers conforming with A. G. C. standards soon after the middle of November.

These facts serve to emphasize the necessity of constructors lending their cooperation to a movement which will mean much to them when fully developed.

Now that the name-plates are being placed upon the mixers which are entitled to bear them, constructors purchasing equipment of this type should make inquiry if the equipment meets A. G. C. standards.

In its substance, the movement for promotion of standardization in manufacture of mixers, as well as that of other equipment used by constructors, has as its aim the effecting of economies and conveniences which are otherwise impossible.—A. G. C. Members' News Letter.

FIG. 4—DIAGRAM SHOWING THE PLAN AND ELEVATION OF PAVER AND CENTRAL STORAGE BINS USED ON MILWAUKEE SEWER CONSTRUCTION



How Transportation Affects Concrete Quality

BY GEORGE P. RIGSBY AND GEORGE F. SCHRAITLÉ

Excerpts from a thesis prepared in connection with Case School of Applied Science.

For several years, experiments have been carried on to determine the feasibility of using a central mixing plant and hauling the mixed concrete to the point of placing. The central mixing plant has been used in highway construction to some extent but in most cases, it has been a matter of using the equipment at hand in the best way. And as, in each case, it was more or less an experiment, no definite conclusions were obtained. The Cleveland Street Railway Co. and the City Street Railroad Commissioner's office, Cleveland, have been working together investigating the possibilities of the central mixing plant and the work described herein is one division of that investigation.

In consequence of the importance of concrete, engineers are experimenting to improve its quality and lower its cost. In this connection a central mixing plant should aid greatly in reaching these objects. Some of the outstanding advantages of this method have been found to be as follows:

I. *Cost:* The cost of operating a central plant is less than any other method of mixing concrete. Some time ago, the City Street Railroad Commissioner's office at Cleveland, Ohio, made an investigation as to the cost of three different methods of mixing concrete. The three methods investigated were briefly:

A. A central mixing plant properly equipped and supplied with storage space from which wet concrete would be hauled to the construction site.

B. Differential concreting train. This involves a mixer at the construction site, which is charged by a continuous belt, materials being supplied by differential trains to receiving platforms and from these fed to the mixer.

C. The method at present used by the Cleveland Railway Co. A mixer at the construction site, materials delivered in the street and later shoveled into the mixer by hand.

In this report the principal items entering into the cost of concreting were:

1. Labor and current consumed in transporting materials.
2. Labor involved in mixing and placing concrete.
3. Investment charges, tax, interest and depreciation on the plant used for each method.

The cost of materials and any overhead expenses properly charged to the job are constant factors and since this is a comparison they were not included.

The following is a summary of the results embodied in their report:

	Method A	Method B	Method C
Hauling materials to the mixer.....	\$75.00	\$156.55	\$311.50
Mixing of concrete.....	130.00	245.00	406.00
Placing the concrete.....	187.60		
Total cost per day.....	\$392.60	\$401.55	\$717.50
Cost per foot of track.....	0.392	0.402	0.717
Cost per yard of concrete.....	1.963	2.01	3.587
Cost of concreting per year.....	41,385.00	42,451.00	75,787.00

II. *Uniformity of Product:* In a central mixing plant a more uniform grade of concrete can be made.

In a stationary plant a system can be installed whereby an accurate measurement of materials can be obtained. Such a system would provide a scientific proportioning of materials in place of the haphazard guess of the foreman of a street gang. Such a method therefore, produces concrete of a better quality by a more economical means.

The tests made of the materials employed included tests for specific gravity, fineness modulus, time of setting of neat cement mortar, and tensile strengths of neat cement briquettes.

Tests of the concrete included compression tests of 6-in. cubes and slump tests. A differential car was used to haul the concrete in the first three tests. This car was one having three rectangular shaped compartments, each 10 ft. square and 2 ft. deep. It was dumped by two movements; first the body of the car was moved a certain distance to one side or the other and then tipped, a 5-ton truck with a flat rectangular bed 6 ft. x 10 ft. and 2 ft. deep was used to haul the concrete in the fourth test. A standard two-bag concrete mixer of the type used by the Cleveland Railway Co. was used, the mixer being mounted on trucks and operated by an electric motor.

Materials used in making the concrete were portland cement, sand, screened through a 1/4-in. mesh, and gravel from 1/4-in to 2-in. in size. The materials were tested on the job according to the specifications of the American Society for Testing Materials. Two bags of cement were used to a batch of 12 cu. ft. of mixed aggregate.

METHOD OF TESTING

The following method was used in testing the concrete.

The time was taken when the mixer was loaded and dumped. An average of one minute was allowed for mixing. It was dumped on a platform on the street. It was then shoveled into the car or truck the sides and bottom of which had been wet to insure easy dumping of the concrete.

A slump test was made at this time to determine the consistency of the concrete. At this time, too, a set of forms was filled.

The concrete was hauled some distance. The length of time of haul lengthened in each succeeding trip. Upon arrival at the destination, the concrete was dumped, the time taken, and another set of forms was filled with concrete which had been hauled.

Both sets of concrete specimens were allowed to set in air one day and were then placed under wet sawdust for 13 days.

On the 14th day after mixing, the specimens were tested for compression in the Olsen testing machine.

CONCLUSIONS

From the tests described in the foregoing, the following conclusions are drawn:

A. The strength of the concrete is not affected by transportation for a period of time up to the limit of these experiments, which was one hour. The slight variations in the results are no greater than what are obtained from different parts of the same batch or difference in tamping.

B. The observations of the concrete during the trip in each case indicated that if the concrete were made dry enough there would be no segregation of the ingredients. There was no segregation of materials in the foregoing tests. The concrete was shoveled into the car in a pile and due to the shaking the pile settled down and some water flushed to the top. But there was no separation of the various materials.

C. From the above results and the report on cost by the City Street Railroad Commissioner, one is warranted in concluding that a central mixing plant is not only feasible, but, in fact, the best of the three methods described.

Concrete in Building Codes

Many building codes continue to place plain concrete on the same basis as solid brick construction in the matter of thickness of walls and partitions—this in spite of the fact that the very same building codes may permit an allowable working stress of 400 to 500 lbs. per sq. in. on plain concrete and only 250 or 275 lbs. per sq. in. on brick walls. Under the circumstances the apparent advantage to concrete because of the higher allowable working stress is in reality no advantage at all, for if the wall thickness must be the same as for brick the actual working stress will be about the same for both materials.

In view of the obviously greater strength of plain concrete, it is refreshing to know that the state building codes of Ohio and Wisconsin and the building codes of some large cities recognize this fact by permitting walls and partitions of plain concrete of less thickness than solid brick walls in similar positions.

Information on building code requirements in this respect has been compiled by the Structural Bureau of the Portland Cement Association. This compilation will be found in the following tabulation:

Wisconsin State Code (See Order No. 5315)—Same thickness as brick for 1:3:6 concrete, but 4 in. less than brick for 1:2½:5 concrete or better.

Ohio State Code (Section 12600—121a, under "Standard Devices")—Standard fireproof enclosures around heating apparatus must be 12-in. brick walls or 8-in. plain concrete walls.

Pittsburgh "General Engineering Regulations" (See page 20)—Minimum thickness of 10 in. for concrete foundation walls. Minimum thickness of 12 in. for brick foundation walls.

Cincinnati (1924) (See Section 432)—Concrete foundation walls must be at least 1 in. thicker than the wall next above and not less than 8 in. Brick foundation walls must be at least 4 in. thicker than the wall next above and not less than 13 in., and must furthermore be of hard brick laid in portland cement mortar.

Dayton (1917)—Concrete foundation walls shall be at least 1 in. thicker than the wall next above, but not less than 10 in. for masonry buildings and not less than 8 in. for wood frame buildings. Brick foundation walls shall be at least 4 in. thicker than the wall next above, and not less than 12 in. thick, and must be of hard brick laid in cement mortar. (See Section 341).

Standard fireproof walls around heater rooms may have a minimum thickness of 12 in. of solid brick or 8 in. of plain concrete. (See Section 333, par. k.)

Portland, Oregon (1924)—Walls of material other than brick shall have the following ratios of the thickness specified for brick: Mass concrete, ¾ of thickness of brick; concrete block and terra cotta tile, same as brick. (See Section 181).

Non-bearing partitions of brick 4 in. thick or of plain concrete 3 in. thick may be built to a height of 12 ft. (See Sections 424 and 426).

Bearing partitions of brick may have a minimum thickness of 4 in. to a height of 10 ft. Bearing partitions of plain concrete may have a minimum thickness of 3 in. to a height of 7 ft. and 4 in. to a height of 10 ft. (See Sections 424 and 426).

Spokane (1919) (See Section 117)—Plain concrete basement walls of 1:3:6 mixture may be built of the same thickness as brick walls. Basement walls of 1:2½:5 mixture or better may be 4 in. less in thickness than brick walls, but not less than the wall above.

Department of Commerce, "Recommended Minimum Requirements for Small Dwelling Construction" (1923)—Minimum thicknesses for bearing walls of dwellings are 8 in. for solid brick and 6 in. for plain concrete. (See Sections 3 and 13, pages 12 and 15).

Party and division walls of solid brick may be 8 in. thick for the uppermost 20 ft. and 12 in. for the remaining lower portion. Plain concrete party and division walls may be 8 in. thick for the entire height. (See Section 28, pages 21 and 22).

Department of Commerce, Tentative Report, "Recommended Minimum Requirements for Masonry Wall Construction" (1924)—Minimum thickness of solid brick bearing walls is 12 in. for the uppermost 35 ft. of height, and 4 in. additional for each successive increment of 35 ft. or fraction thereof. Plain concrete walls may be 10 in. thick for the uppermost 35 ft. of height, and 4 in. additional for each successive increment of 35 ft. or fraction thereof (See Sections 5 and 19).

Minimum thickness of brick non-bearing partitions is 4 in. for a height not exceeding 12 ft. Plain concrete non-bearing partitions may be 3 in. thick for a height not exceeding 12 ft. (See Section 41).

National Fire Protection Association (40 Central St., Boston), in printed report of Committee on Building Construction (for dwellings)—Party or fire division walls of solid brick may be 8 in. thick for the uppermost 20 ft. of height and 12 in. for the remaining lower portion. If of plain concrete, the thickness may be 8 in. for the entire height. If of reinforced concrete, the thickness may be 6 in. for the entire height. (See Section 6, Art. 3, subparagraph "h").

USE OF HOLLOW CONCRETE BLOCK AND TILE IN PARTY, FIRE, AND DIVISION WALLS

(QUOTATIONS FROM BUILDING CODES)

The use of hollow concrete block and tile in party, fire, or division walls is permitted in some recent city building codes and also in both of the codes thus far prepared by the U. S. Department of Commerce Building Code Committee. The actual wording used in the codes, and the section numbers, will be found in the following paragraphs:

Hoover Dwelling House Code. A paragraph in Section 28 of this code, published by the U. S. Department of Commerce in January, 1923, under the official title of "Recommended Minimum Requirements for Small Dwelling Construction," reads as follows: "The minimum thickness of party or division walls of hollow building tile or hollow concrete block or of hollow-wall construction shall be 12 in. No such walls shall be broken into for the insertion of building members."

Hoover Masonry Wall Code. This proposed code, issued in tentative form under date of September 1, 1923, and under the title of "Recommended Minimum Requirements for Masonry Wall Construction," reads as follows in Section 35: "Fire walls of clay hollow building tile or hollow concrete block shall be not less than 16 in. in any part except that in residential buildings not over three stories high they may be 12 in. thick throughout. Hollow walls of brick used as fire walls shall be not less than 12 in. thick throughout. No fire walls of the above types shall be broken into for the insertion of building members."

In the foregoing paragraphs only fire walls are mentioned specifically by name. However, a party wall or a division wall is merely a special case of a fire wall, and the expression "fire wall" is intended to be used in that sense. A later revised draft of this proposed code makes specific mention of division walls, for which hollow concrete block and hollow concrete tile are permitted to the thickness specified for fire walls in the foregoing paragraphs.

The Hoover masonry wall code is now (November, 1924) in the hands of the printers.

Cincinnati. Ordinance No. 80—1924, passed April 1, 1924, contains the following in Sections 433-6 and 433-9:

Use. Hollow concrete building units which have the approval of the building commissioner may be used in building construction in accordance with Sections 433-7, 433-8, 433-9, and 433-10 wherever solid masonry is permitted. Hollow concrete building units may be used for fire walls in accordance with the regulations of the Ohio State Board of Building Standards.

Party, Division and Curtain Walls. The minimum thickness of non-bearing party or division walls of hollow or solid concrete block shall be 8 in. for lengths not exceeding 20 ft. and maximum height 14 ft., and 12 in. for lengths not exceeding 25 ft. and maximum height 14 ft. The minimum thickness of curtain or panel walls under windows in skeleton frame construction shall be 8 in., provided said curtain wall is not over 4 ft. 6 in. high and 20 ft. long.

Where hollow concrete block in a party or division wall is broken into for the insertion of building members, such members must be staggered.

Columbus. Ordinance No. 33,743, passed February 12, 1923, contains the following in Section 32-19, under the heading of "Party Walls:—"

Walls of hollow concrete units used in the construction of party walls shall be filled in place with concrete in the proportion and manner described in Section 32-13.

Indianapolis. The Ordinance passed May 19, 1924, known as General Ordinance No. 46—1924, reads as follows in subparagraph (e) of Section 3:

The interior fire and load-bearing concrete block walls of any residence, duplex or double duplex building shall not be less than 8 in. thick for the uppermost 20 ft. and 12 in. thick for the next lower 14 ft. in height.

Camden, N. J. The three paragraphs composing Sections 7 and 10 of the "Ordinance Regulating the Manufacture and Sale of Concrete Block and Concrete

Structural Tile for Bearing Walls and Piers," adopted September 28, 1922, reads as follows:

Concrete building block which have the approval of the Building Department may be used for buildings wherever solid masonry is permitted by this Code, subject to all the limitations required for solid masonry and subject to the allowable working stresses and provisions of this Code.

The minimum thickness of party or division walls of hollow building tile or hollow concrete block or of hollow-wall construction shall be 8 in. for spans not exceeding 18 ft. and 12 in. for spans not exceeding 24 ft.

Hollow building tile or hollow concrete block in a party or division wall may be broken into for the insertion of building members; such members, however, must not butt, but must be staggered.

It is significant that, of the six ordinances quoted, only one requires hollow units used in fire walls to be filled with concrete. This is in Columbus. The other city ordinances and both the recommended codes of the U. S. Department of Commerce Building Code Committee permit the use of hollow units without filling.

Gunité Protection for Steel Structures

Conclusions drawn as the result of experiments at Leaside, Ont., with two 42-ft. steel plate girders covered with gunité to ascertain the cause of superficial cracks on Hamilton bridges, favor the employment of the guniting process for the protection of steel structures. The cause of the cracking of the gunité coating on steel girder bridges in the city of Hamilton, Ont., which were covered with gunité in order to protect them from the corrosive action of locomotive blasts, the remedy for such cracking and the extent, if any, to which it exposed the metal beneath to corrosion were questions, the solution of which, led to experiments reported by Peter Gillespie and P. J. Culliton of the University of Toronto, in the *Canadian Engineer*.

The Canadian National R. R. donated two superceded 42-ft. steel plate girders and through the further cooperation of the Honorary Advisory Council for Science and Industrial Research, the Canada Cement Co. and the Cement-Gun Co., of Allentown, Pa., the experiments were made possible. The girders were set up at Leaside, Ont., and to them gunité was applied, the thickness of the coating, the reinforcing fabric, the ingredients and proportions constituting the variables of the problem.

The following are the conclusions which appeared to the authors to be warranted in the light of observations covering two years on the Hamilton bridges and 19 months on the Leaside girders:

In the application of gunité, coarse sand rebounds to a greater extent than fine sand.

Local pockets of unmatrixed sand resulting from inadequate mixing of ingredients in the machine are a cause of rusting on both plates and reinforcement.

Impurities such as clay and loam seem to favor rusting of the imbedded fabric.

The expansion of gunité between the dry and saturation points is about .0002 per lineal unit.

Reinforcing fabric is necessary where steel work is to be protected by gunité. It should be sufficient in amount to enable it to assume, in event of rupture of the gunité, the tensile stresses produced therein by shrinkage.

The reinforcement should be not closer to the plate than $\frac{3}{8}$ in. One and one-half inches should be an adequate overall thickness for the covering layer.

Where the fabric is tightly wrapped over stiffeners and the covering thereon is less than $\frac{1}{2}$ in. thick, vertical cracks corresponding to the outstanding leg of the angle tend to develop. These cracks sometimes extend through to the steel angles and in several cases rusting of the reinforcement has occurred. Vertical cracks obviously permit the entry of water more easily than horizontal cracks.

The application of a top or surface coat not adequately bonded to the first favors the formation of surface cracks.

Cracks in gunité at the Leaside girders can be traced only as far as the plane of the reinforcing fabric. The only exceptions to this are in the panel having no reinforcement and on the edges of stiffener angles.

Lean mixtures check less than the rich ones.

Frequently when gunité has been chipped from the center of a panel, cracks radiating from the opening have been observed to develop in the course of a few weeks following the chipping. This is particularly noticeable where the shell of gunité is very thick. This shows the effect of lack of continuity in the covering envelope.

Widths of cracks in gunité respond more readily to humidity changes than to temperature changes.

A layer of gunité applied to heavily-rusted steel plates resulted in the complete suspension of the rusting process when the plates, together with their covering, were alternately immersed and dried and exposed to severe weather conditions during a period of nearly 12 months. The imbedded fabric was always perfectly preserved.

A humid atmosphere failed to produce rust in three months on bright steel rods covered by one inch of gunité in which cracks .09 in. and narrower had been made. Rust, however, was produced by this same atmosphere in one month on bright-steel rods covered by one inch of hand-placed mortar in which cracks .15 in. and wider had been made. Uncovered steel rusted excessively under these conditions.

Spots of rust on steel cores of hand-made specimens appear to be the result of insufficient puddling of mortar when the specimens were made. It is believed, however, that such rusting soon ceases under the covering shell.

Fabric which had been completely surrounded by gunité was always perfectly preserved against rust.

Where good materials and workmanship are assured, and the weather during application is favorable, gunité properly reinforced is believed to afford a satisfactory protection for steel structures against corrosion.

Bureau of Standards Conducts Numerous Tests

Scientific investigations and tests resulting in large savings to the government and the American industries through improvement in processes and the fixing of uniform standards are featured in the annual report of Dr. George K. Burgess, director of the Bureau of Standards, submitted to Secretary of Commerce Hoover, in November. Investigations made during the year including corrosion of underground pipes, tests conducted covering impact stresses in highway bridges, and other studies have resulted in the application of improved methods in engineering practices that are of direct and substantial savings to the industrial public.

An increase of more than one hundred and twenty-five times its initial volume has taken place in the testing work of the Bureau of Standards during the 23 years of its existence, the reports states. Most of the tests of the past year were executed for other branches of the government, practically every branch making use of the facilities provided. A great deal of testing was done for commercial firms and for individuals, but as the government work is given precedence, in some cases all testing except that for the government had to be refused because the demand exceeds the facilities for doing this work.

It is stated by Mr. Burgess that the Bureau has no intention of entering into competition with commercial laboratories but there are certain classes of work which it is considered desirable for it to undertake because the results would be of public benefit.

If you have a good, well-tried construction kink, why not pass it on to the other fellow?



PLANT ENGINEER, TURNER CONSTRUCTION CO.

The canvas cover repair room is equipped with a

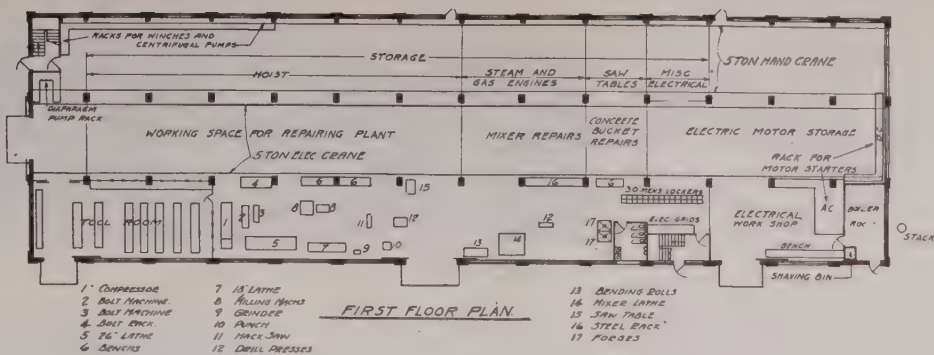
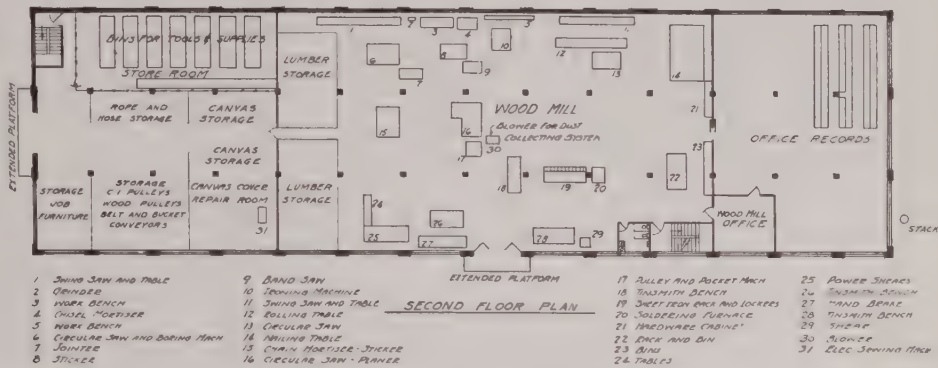


FIG. 3—SECOND FLOOR OF SHOP INCLUDING THE WOOD MILL



special sewing machine, motor driven, where all our covers which are used for winter weather protection, and the waterproof covers used for protecting monolithic floors and cement are repaired. Two men are employed who do nothing but repair covers throughout the entire year.

The office record storage room is used for storing office and job records. These records are put in steel filing cabinets placed back to back, leaving an aisle between every two rows. The records are filed systematically so that they can be readily referred to.

In the yard there is a 15-ton 8-wheel locomotive crane with a 40-ft. boom which is used for loading and unloading all freight cars and trucks which come into and leave the yard. This crane is also used for handling all material to and from the woodmill on the second floor and can be used for handling supplies to the second floor stock room at the front of the building. An extended platform has been built at the woodmill and at the front of the building for placing and removing materials with the crane. A 7½-ton stiffleg derrick with a 75-ft. boom, electrically operated, has been erected



FIG. 4—LOOKING THROUGH THE SHOP—MOTOR STORAGE IN FOREGROUND

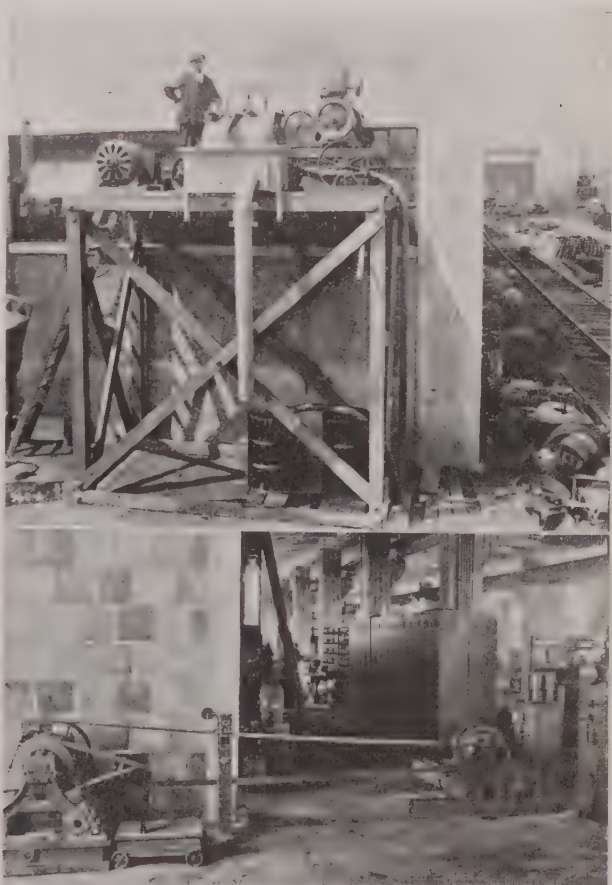


FIG. 5—APPARATUS FOR TESTING PUMPS. WATER IS PUMPED FROM A TANK UNDER A SUCTION LIFT OF 12 FEET, THE WATER BEING DISCHARGED BACK TO THE TANK

FIG. 6—MOTORS AND STEAM AND GASOLINE ENGINES ARE TESTED UNDER LOAD. AN ADJUSTABLE BEDPLATE HAS BEEN PROVIDED SO THAT MOTORS AND ENGINES OF ANY SIZE MAY BE BOLTED TO IT

in front of the building. This derrick covers the area where heavy machinery, not requiring weather protection, is stored, such as concrete mixers and concrete buckets. The derrick is so placed that it can be used, if necessary, for loading and unloading freight cars and trucks and for placing and removing materials to and from the extended platform on the second floor of the building.

The following equipment for handling machinery has been installed in the building on the first floor: a 5-ton hand-operated trolley crane running the full length of the building and spanning the width of one bay over machinery storage. A 5-ton electric-operated trolley crane running the full length of the building, spanning the width of the center bay where machinery is repaired. This crane will pick up a 5-ton load at 12 ft. per minute and travels at the rate of 175 ft. per minute. The crane installed was purchased because it required very little headroom which meant a lower first story height when the building was erected. There is sufficient headroom on the first floor so that an automobile truck can be driven into the building and loaded by this electric crane. In the electric and machine shop are erected several I-beam trolleys with chain hoists.

It is advisable to test certain equipment before sending it to jobs to make reasonably sure that it will operate satisfactorily on its arrival. The pictures show a pump test platform for testing all pumps and Prony brake for testing motors, steam and gasoline engines.

On account of having motors of varying characteristics and since we are only supplied with 220-volt, 60-cycle, 3-phase current in our yard, we have installed a series of transformers to test other A. C. motors. For testing 110-volt, 220-volt and 500-volt D. C. motors we have installed three generators.



FIG. 7—CONCRETE MIXER IN LATHE

FIG. 8—THE MACHINE SHOP



FIG. 9—GENERAL VIEW OF YARD

It is considered too difficult and expensive to test such items as concrete mixers, belt and steam hoists under load. For this reason they are tested by running without load. Items such as electric drills, air tools, electric floor surfacers and grinders are tested by operating under load.

The company has spent a great deal of money on this new yard and shop endeavoring to make it the best contractor's yard in the country. The shop management makes every effort to take full advantage of the exceptional shop facilities now available and to see that equipment is sent out in the best of shape. If any item of plant is received in poor condition or later fails to stand up under service, the superintendent is requested to be sure to send in a written statement of the nature of the defect in order that the shop may try to avoid a similar trouble in the future. Statements should also be sent in when plant has been damaged in transit describing whether the damage has been caused by insecure blocking and bracing or other carelessness in loading.

In returning plant to the yard, superintendents help the plant department by calling attention to any defects that have been noticed when the plant was in operation.

Strength of Sand-Cement Block with More Water

Some concrete building unit manufacturers in and around Brooklyn, N. Y., are handicapped in economical production of satisfactory products by a scarcity of aggregate containing enough coarse material. Aggregate containing plenty of coarse particles makes better concrete for less money than sand, so commonly used. One producer, so handicapped, made a very careful study, experimenting to see if he could get satisfactory strength with block having 40% air space in place of 33⅓%, with a leaner mix than a 1:5½ or 1:6 by using more water than he had been using in his tamp equipment.

CONCRETE is advised that in spite of his admittedly fine aggregate he is going to be able to do it. The most interesting part of the test is that block just a week old were able to show such good strengths. Steam curing is, of course undoubtedly responsible.

Tests made at Columbia University November 5, 1924, on block with 40% air space and made with a 1:7 mix, on a Besser single automatic machine, showed these results the dates indicating day block were made:

October 9.....	1130 lbs.
October 9.....	1075 lbs.
October 9.....	1385 lbs.
October 19.....	990 lbs.
October 19.....	750 lbs.
October 29.....	710 lbs.
October 29.....	900 lbs.

Cements and Cement Manufacturers

Notes on the Centennial from the Cement User's Viewpoint

BY HARVEY WHIPPLE



BLAINE SMITH, NEW PRESIDENT
PORTLAND CEMENT ASSOCIATION

The comings, goings and doings of cement manufacturers is of interest to the users of cement, not because of any deep concern in the technologic discussions by chemists and superintendents of kilns and crushers, slurry and clinker, coal dryers and compebs, but because, and only so far as, these discussions foretell an improvement in the product, or a lower price, or any altered policy of producer toward consumer. The reports of meetings of the cement manufacturers, in-so-far

as these meetings are open to the public, are usually to be found therefore, only in the MILL SECTION of this magazine.

In November, however, the Portland Cement Association, as a special feature of its annual meeting, held "a party" in distinguished celebration of the patenting of portland cement 100 years ago by Joseph Aspdin, a bricklayer of Leeds, England. This meeting had in it a great deal that should be of interest to the user of cement—not in detail but in effect—interesting as indicating how the problems of the cement user are translated into highly technical manufacturing problems that affect the whole status of the cement manufacturing industry.

The cement industry in general has been criticized, and in some cases with justice, as being rather smugly contented with its product and concerned chiefly with measures which increase the economy of production and the margin of profit.

While the cement producers are doing pretty well these days, they have—at least most of them have—seen some mighty lean times. If they are making money now it cannot be laid up against them that the price of cement has increased as has the price of other construction commodities. They are doing better under something nearer capacity production which a lively market has made possible, and they are doing better by internal improvement in their own processes and the elimination of waste.

With temperatures high enough to "calcine to incipient vitrification" the raw materials which are fed to the kiln, a good many dollars have been going up the stacks in clouds of British thermal units which might have done a good deal of extra work, especially as cement mills have sundry other uses for heat and burn nearly two hundred pounds of coal for every barrel of finished product.

It is of interest to the user of cement therefore that the manufacturers are able to accumulate enough sur-

plus to put in waste heat boilers—a rather costly installation—and otherwise look to further economies of production. In a paper by Helmuth Krarup, superintendent of the Hawkeye Portland Cement Co., on "The Economic Limit of Operating Flexibility of Waste Heat Boiler Installations" which was an unusually thorough treatise, it was also developed that waste heat boiler installation makes necessary a closer study of the conditions of kiln operation, and this closer study is in itself an advantage to the industry.

A good deal of impetus has been given to the work of conservation and a special bureau of the Association has done important work in this direction. Conservation in another respect—conservation of the human element of cement production makes another field of study and active work—namely, accident prevention.

The progressive spirit is also obvious in other directions—in relation to the nature of the cement product. The smug attitude of "let well enough alone" is breaking down before the insistent interest of the cement user in the possibilities not only of a better cement than our present standard product but different cements to meet special requirements.

As long as the user of cement was reasonably contented with portland cement as is, it was but natural that the producers should find promotional advantage in rallying around one standard and discretely refraining from exploiting their respective brands for special or extra standard characteristics or behavior.

Enough users of cement know nowadays that brands mean something, so that the producers have a new urge in the direction of developing special cement characteristics to suit special conditions.

The period of promotional concentration was a good thing. It has developed the uses and application of concrete and by such development has hastened the day when diversification may have its inning. This too is healthy. The cement manufacturers will make a new kind of progress.

All this may be said to be a boiled down interpretation of what cement producers may be thinking. This thinking has been hastened by the reports from abroad in the last few years of the achievements with high alumina cement. Now that high alumina is a domestic product, for which innumerable uses are being found which make it cheap commercially, even at its high price, the cement producers were able to listen with the liveliest interest at their Cement Centennial to discussions not only of high alumina cement and its special attributes, but of other high early strength cements which are more closely akin to portland and therefore more easily thought of from a manufacturing standpoint.

Dr. Gustave Haegermann, director of the German Portland Cement Association's laboratory, in a paper of unusual interest, made it quite clear that there are other opportunities to develop quick-hardening cements than by the high alumina route and perhaps of considerable economic importance for two reasons—the

more readily accessible materials and the escape from a necessity to "sell" a comparatively new product to the engineering profession—since these developed cements referred to by Dr. Haegermann are true portlands.

The annual meeting concluded with a day set apart for a purely centennial program. F. W. Kelley, president of the Helderberg Cement Co., who retired after two years as president of the Association, was the recipient of an engrossed and beautifully bound "appreciation" carrying the gratitude of the Association for his services. It is noteworthy that Robert W. Lesley, first president of the Association, made a very graceful address as a part of the banquet program in which he told for what notable work each of the succeeding presidents of the organization had to be

thanked, concluding with Mr. Kelley, whom he dubbed "the internationalist." It was in Mr. Kelley's administration that the Association came to a fuller realization that the solution of technologic problems is in no way circumscribed by national boundaries. In the last few months many of the cement people have been abroad making a very close study of methods and results in the noteworthy cement plants of Europe and the British Isles, stopping at Leeds to dedicate a tablet to Joseph Aspdin. Reciprocally the American centennial celebration was graced by the presence of many guests from abroad, several of whom spoke briefly in the course of the afternoon. (This program is mentioned more in detail in MILL SECTION pages).

Blaine Smith, general sales manager of the Universal Portland Cement Co., is the Association's new president.

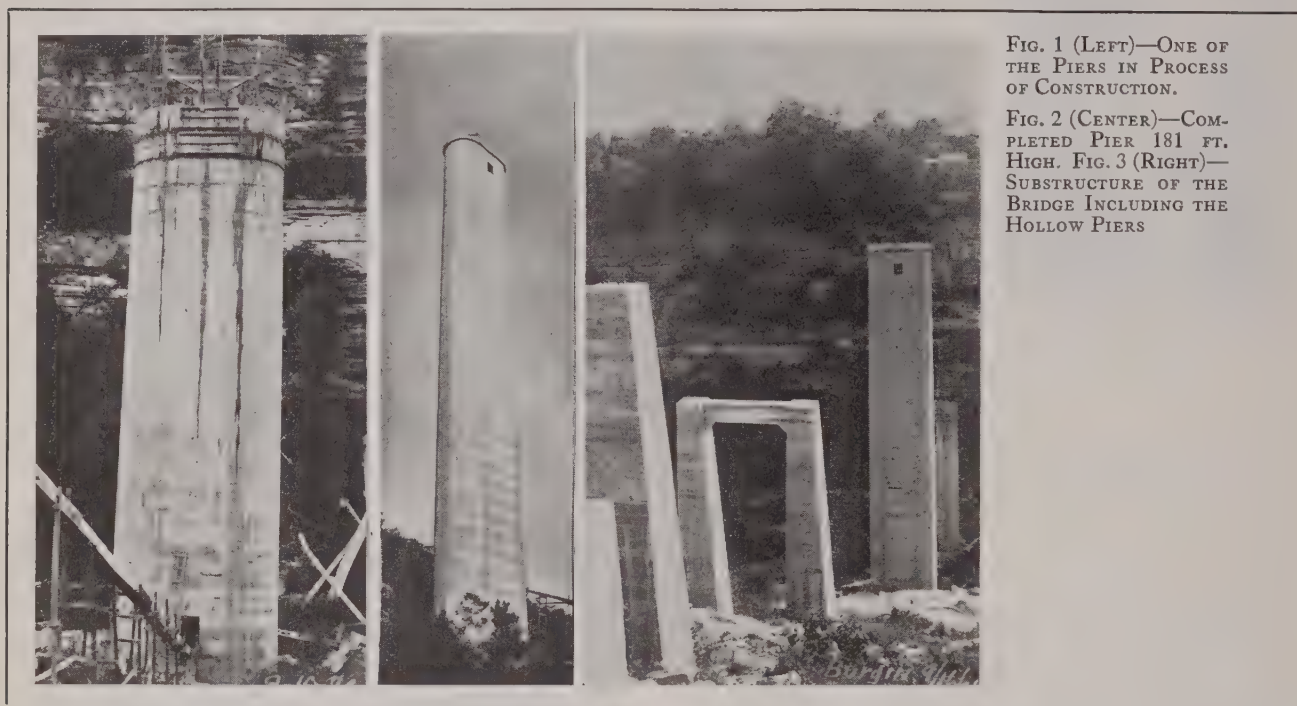


FIG. 1 (LEFT)—ONE OF THE PIERS IN PROCESS OF CONSTRUCTION.

FIG. 2 (CENTER)—COMPLETED PIER 181 FT. HIGH. FIG. 3 (RIGHT)—SUBSTRUCTURE OF THE BRIDGE INCLUDING THE HOLLOW PIERS

Concrete Bridge Piers Built Hollow Like Chimneys

An unusual method of constructing hollow reinforced concrete bridge piers with round ends and flat sides to support a road bridge across the pond which will be formed by the Dix River dam, Ky., is described in *Engineering News-Record* from which the following is abstracted. Both ends and sides taper and the thickness of the shell also diminishes gradually from bottom to top.

The bridge piers which are virtually chimneys are hollow concrete tubes built by the Weber Chimney Co., Chicago, by its regulation chimney building process, the highest pier being 221 ft. from the base to the top slab which forms the cap. This pier rests on a foundation 35 ft. square, consisting of a slab 6½ ft. thick, reinforced 6 in. from top and bottom with 1-in. round rods. The shaft is anchored to the foundation by 1-in. and ¾-in. vertical bars. The shell which is 28 ft. 4⅞ in. x 18 ft. 4⅞ in. at the bottom has a thickness of 26⅞ in. Reinforcing rods consist of ½-in. rods

spiraled with a pitch of 12 in. around the outside of the vertical bars.

Each pier is made 12 ft. wide and 22 ft. long at the top with a reinforced concrete slab cap. Shell ports 3½ ft. square are provided at the top and bottom to permit the pier to fill with water when the surrounding pond is filled.

Both sides and ends taper toward the top and the shell thickness decreases gradually from the bottom to the top. There are flat faces in each side and the ends of the pier are round. At intervals of 45 ft. in height, a transverse beam 12 in. x 30 in. of reinforced concrete connects the flat faces.

Construction was carried on with 2 rings of regulation Weber chimney forms, 4½ ft. high. The two rings were alternately filled and lifted one above the other. The mixer was located about 300 ft. from the site of the pier and 70 ft. up the hill. The concrete was chuted 250 ft. to the ground and hoisted inside of the pier with the aid of two hoists. The concrete used consisted of 1-in. stone, with fine crushed stone for sand, mixed according to proportions determined by field tests.

The piers were designed by engineers of the Weber company cooperating with L. F. Harza, chief engineer of the Dix River dam and hydro-electric development. These piers are believed to be the first work of this kind that has ever been done.

Graded Aggregate

Wanted—An Engineer-Executive

"Wanted—a competent executive with engineering experience if possible," so says a liner ad in this issue. We happen to know that the job is of a kind which might develop into something interesting. The liner ad goes on to say "— to take charge of an association of dealers in a steel industry. Give references and past experience."

* * *

Building to Have Shock Absorbers

The following paragraph is a high light from the discussion recorded in the proceedings of the tenth annual meeting of the Building Officials Conference held at Louisville, Ky. The discussion which led up to it pertained to stresses induced in tall buildings by wind pressure and the provisions to be made in the design for wind bracing in such tall buildings.

It is only within a week that I read of a building designed to be built in San Francisco that is going to be built to guard against earthquake shocks. The foundation is to be of reinforced concrete covered with steel plates. Then on top of the steel plates are to be placed steel rollers extending in both directions; on top of the steel rollers another steel disc is to be placed and on top of the steel disc they will erect the building. It is also going to be provided with "shock absorbers."—F. W. Lumis, Inspector of Buildings, Springfield, Mass.

* * *

Reinforcing Bar Standard Sizes

In accordance with the unanimous action of the joint conference of representatives of manufacturers, distributors and users of square and round steel reinforcing bars, the United States Department of Commerce, through the Bureau of Standards, recommends that the recognized sizes of square and round steel reinforcing bars, in terms of cross sectional area, be reduced to the following:

Area in Square Inches	Size in Inches
.049	1/4 Round
.110	3/8 Round
.196	1/2 Round
.250	5/8 Round
.307	3/4 Round
.442	7/8 Round
.601	1 Round
.785	1 Square
1.000	1 1/8 Square
1.266	1 1/4 Square
1.563	1 1/2 Square

It is further recommended that this reduced list of areas become effective as applying to new production January 1, 1925, and that every effort be made to clear current orders and existing stocks of the eliminated areas before March 1, 1925.

* * *

Adhesion of Gypsum Plaster to Concrete

In a report published in the Proceedings of the American Society for Testing Materials, one of the conclusions reached was that a gypsum plaster could be made which would have under the same conditions approximately the same coefficient of expansion as a concrete, provided the characteristics of the concrete were sufficiently studied. As this work was conducted upon gypsum obtained in the open market, the question

arose as to the effect of age upon the volumetric properties of gypsum plasters. At the request of the Gypsum Committee of the American Society for Testing Materials this investigation was reopened by the Bureau to answer this question.

Samples of freshly calcined material were obtained from mills located in various parts of the country, together with the sand used in different localities. From these materials test specimens were made, using the sand and gypsum which might be found in a given locality. These were tested for expansion, using the freshly calcined material, and there has recently been completed a series in which the calcined gypsum has been exposed to the air for a six months period. In each case the gypsum was analyzed to determine its composition. The results of this work bring out the following:

1. Freshly calcined gypsum shows a loss in $\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$ content on exposure.

2. Specimens made from aged plaster show a greater expansion and contraction with humidity changes than with freshly calcined material.

3. With a specific gypsum and a specific sand a gypsum mix can be made having approximately the same expansion under similar conditions as a concrete, provided a sufficient amount of data is available upon the expansion characteristics of the gypsum with the sand and the concrete in question.

4. In some cases a manufacturer has never experienced a failure of bond between gypsum plaster and concrete. This may be attributed to the composition of the calcined gypsum produced and that it was used unknowingly with such a proportion of the proper sand as to give a plaster which behaved similarly to the concrete with respect to expansion, when subjected to the same conditions.

* * *

Paint Keeps Lime Plaster from Setting

That oil paint applied to the surface of fresh lime plaster has a decided tendency to hinder the setting of such plaster is one of the conclusions drawn from a series of tests made by the Bureau of Standards. The setting of the plaster results from the absorption of carbon dioxide from the air and the resulting change of the hydroxide, or slaked lime, into limestone.

This absorption of carbon dioxide is very greatly hampered by the paint film, the bureau finds. It is retarded, but not seriously, by a finish coat, and takes place more rapidly in lean mortars than in rich. The combination of a finish coat with a film of oil paint on top of it was subsequently tried, and was found to prevent the absorption of carbon dioxide almost entirely, cubes of plaster in this way showing no appreciable penetration of carbon dioxide after a period of six months.

In all, 144 two inch cubes were made for the test. Four different types of lime were used, and the mortars were made in three different proportions of sand and lime. Twelve cubes were made from each mortar, of which four were left as molded, four were covered with a white finish coat, and four were covered with an oil paint. One-fourth of the cubes were tested each month to determine the condition of the lime and the amount of carbon dioxide absorbed.

* * *

Stadium Designers Measure "Rooter" Stresses

Added stresses in the steel reinforcement of a concrete stadium due to the vigorous enthusiasm of the crowd were measured during a recent game by means of the carbon resistance strain gages developed by the Bureau of Standards. By using these gages it was

possible to record automatically the variations in the loading of the steel when the crowd all rose in a body or stamped in time to the band.

Such mass movement, it has long been known, may increase the live load on the structure far beyond that caused by the people when sitting or standing still or moving at random, but until recently it has not been possible to obtain an accurate record of such sudden changes of stress. In this particular test the live load when the crowd was still was found to increase the stress in the steel by about 1,000 lbs. per sq. in., whereas 4,000 lbs. would have been considered safe. Under the worst conditions occurring during the course of the game the movements of the crowd sometimes gave an additional 300 lbs. per sq. in.

It is pointed out, however, that the worst conditions from the point of view of safety arise when the crowd, in stamping rhythmically, happens to strike the natural vibration period of the structure. It has been reported that under these conditions the stress has exceeded the static live load by as much as 150%.

Tests of impact stresses in other stadiums are being made from time to time, and the data being accumulated are expected to be of great value as a guide in the design of such structures. Great uncertainty now exists as to the allowance to be made for impact stresses. It is desirable to keep down the weight, and hence the cost of the structure, but at the same time safety is indispensable.

In making the test the concrete was removed from the reinforcement over short lengths, and the gages were attached directly to the steel. After the test the holes were concreted over again.

A gage of this type depends for its operation on the fact that stacks of carbon rings undergo a change in resistance with change in pressure. It is so arranged that a small change in the distance between the points of attachment to the structure causes a change in the pressures on two of these carbon stacks, the pressure on one being reduced while that on the other is increased. The change in distance is caused by a change in the load carried by the steel.

This gage is connected by three electric wires to the indicating or recording device, and these wires may be of any desired length. Changes of load are followed very rapidly, and those lasting only a fraction of a second can be recorded as well as changes of longer duration.

* * *

Road Show

The annual convention of the American Road Builders' Association will be held at the Congress Hotel, Chicago, January 6, 7 and 8, with the Road Show at the Coliseum and adjoining buildings, January 5 to 9.

* * *

Strength of Hollow Tile Concrete Floor Slabs

The Bureau of Standards, in cooperation with the Hollow Building Tile Association, recently completed a series of tests on specimens of combination hollow tile and reinforced concrete floor slabs, reinforced in but one direction. The tests were planned to determine the extent to which the tile could be relied upon in resisting bending and shearing stresses.

Forty-four slabs, varying from 8 ft. 10 in. to 15 ft. with a total depth of 8 in. and a maximum width of 30 in. were tested. The combination slabs consisted of two 4-in. concrete ribs separated by a single row of tile, laid with their cells parallel to the length of the slabs, and enclosed on each side by a row of tile sections which had been cut to include nearly one-half

their original width. In some of these slabs 8 x 12 in. tile were used without a topping, and in others 6 x 12 x 12 in. tile were laid and covered by a 2-in. concrete topping. For comparison 2-in. solid concrete slabs having the same gross sectional area as the composite slabs, and 3-in. solid concrete beams having the same sectional area as the area of the concrete ribs in the composite slabs were tested. A greater amount of tensile reinforcement was used than is ordinarily employed in practice in order to prevent the failure of the steel before high stresses in the concrete and tile had been developed.

The specimens were tested in a vertical-screw beam-testing machine having a capacity of 600,000 lbs. The deformations in the concrete, tile, and steel, and the deflections of the slabs were measured as the loads were applied. By changing the positions of the loads, bending and shearing stresses several times greater than working stresses for concrete were developed.

It was found that the bond between the concrete and tile was sufficient to cause the tile to assist materially in resisting both bending and shearing stresses. The value of the tile in beams without a concrete topping was almost directly proportional to the modulus of elasticity of the tile. When medium or hard tile are used, it appears that the shells of the tile which are in contact with the concrete are as effective as an equal width of concrete would be. A full report on these tests is now being prepared for publication.

* * *

Concrete Strengths at 28 Days Determined by 7-Day Test

In the recent movement to secure strength of concrete as great at 28 days as that assumed or specified by building regulations, one of the greatest difficulties has been due to the fact that rejection of concrete which failed to meet the strength requirements was often almost impossible because of the large amount of concrete which had been placed upon it during the 28 days before it was tested, says the U. S. Bureau of Standards. Results of recent field tests carried out on the concrete furnished in construction jobs suggested that there was a somewhat consistent relation between strengths at 7 days and those at 28 days. Further study has shown that the strength at 28 days based upon tests of laboratory specimens stored in damp sand has been equal to approximately the 7-day strength plus 30 times the square root of the 7-day strength. This relation has held true for concretes made from a large number of portland cements and for a large range of mixes. Since the strength at 7 days is likely to be nearly independent of the method of curing, this relation gives promise of affording a useful criterion for estimating at an early age the 28-day strength of concrete used in construction work.

This application to the field testing of concrete should not be confused with the problem of determining in advance from suitable tests the adaptability, for any given work, of the concrete materials proposed for use in that work. The use of the criterion here described would not remove the necessity for these latter tests of the materials.

* * *

Young But Experienced

Clifford M. Holland was the perfect example of the specialist in engineering. To become the chief engineer of the greatest subaqueous tunnel project in the world at 36 requires exceptional ability and a dominating personality, but more than that it requires that the 13 prior years be crowded with experience in the new work

CONCRETE

to be undertaken. The ability and personality Holland had, but in 1919 when he was chosen to build the Hudson vehicular tubes he had besides the most extended and intensive experience tunneling around New York City of any man of his time, of whatever age. He came to his new job young and eager but equipped as were few other men in the profession and he carried it along with characteristic energy and efficiency. That he should have to die the very day before the first tube was holed through adds a special touch of tragedy to his untimely passing—*Engineering News-Record*.

* * *

House Plumbing

Tests on the Hydraulics and Pneumatics of House Plumbing by Harold E. Babbitt is issued as University of Illinois bulletin No. 47 and as bulletin No. 143 of the Engineering Experiment Station. It is a book of 80 pages and cover, reporting tests which were undertaken with a view to obtaining definite information concerning the pressures found in waste pipes, sewer pipes, traps and vent pipes, and the limitations of rates of discharge of waste pipes and storage tanks.

* * *

Stave Silo Men Meet

The ninth annual meeting of the National Concrete Stave Silo Association is being held at Hotel Sherman, Chicago, as this magazine goes to press. The program includes among other items, papers and reports as follows:

"The Need for Standard High Quality Staves," by M. B. Fry, president, National Concrete Stave Silo Association; "Economical Products Manufacture", by C. L. Bourne, engineer, Cement Products Bureau, Portland Cement Association; "How We Doubled the Strength of our Product", by William Trost, president, Waterloo Concrete Corp., Waterloo, Iowa; "The Concrete Stave Tests," by W. G. Kaiser, secretary-treasurer, National Concrete Stave Silo Association.

A joint session of The National Concrete Stave Silo Association and Silo Department, N. A. F. E. M., includes an address by C. O. Mitchell, chairman, Silo Department, N. A. F. E. M.; "Putting Silos Back on the Map," by Noble T. Praigg, Praigg, Kiser & Co., Chicago; "Silo Publicity," by Prof. A. L. Haecker, Lincoln, Nebr.; "Agriculture and the Rest of Us," by C. D. Hardy, Swift & Co., Chicago; Open discussion of credits, collections, trade principles and practices, and other mutual business problems.

"Our Experiences with Silo Washes," by W. W. Gurney, Madison Cement Stave Silo Co., Sparta, Wis.; "Shall We Use Galvanized Hoops," Meaker Galvanizing Co., Chicago; "Concrete Staves for Corn Cribs, Granaries and Other Farm Structures," by H. A. Fraser, Ribstone Crib and Silo Co., Joliet, Ill.; "Building Troubles I Have Had and How I Overcame Them," Series of five minute talks by manufacturers.

* * *

Engineer Heads Health Association

For the second time in its existence of over half a century the American Public Health Association has elected an engineer as president. Forty years of its history elapsed before the association bestowed its highest honors on an engineer, in the person of the late Rudolph Hering. Now after 13 years more another engineer has been given a like honor. It is true that primarily Dr. Henry F. Vaughan owes his elevation to the presidency to his record as health commissioner of Detroit, but his education and his professional experience prior to his Detroit appointment were in engineering and he is a D. P. H. rather than an M. D. Although two engineer-presidents in over fifty years is scant recognition of the part that the engineering profession has taken in the advancement of public health, it is good as far as it goes. It will not wholly eradicate the feeling that the A. P. H. A. is too much dominated by the medical profession, but it will help. As time goes on, if the title of "doctor" be considered by a majority

of the members as a pre-requisite to appointment as health officer and to election as president of the A. P. H. A. it will be D. P. H. rather than M. D. that will count.—*Engineering News-Record*.

* * *

Overseas Trade

Foreign Commerce Handbook for 1924-1925 has been issued by the Foreign Commerce Department, Chamber of Commerce of the United States, as a pamphlet of 40 pages contributing to a wider appreciation of the facilities available to American business men in the conduct of their overseas trade.

* * *

The Craftsman

"Your editorial," writes a reader of CONCRETE, referring to the November issue, "expresses a thought which should be of value to craftsmen and to scientists; It is a rule by which values may be measured; by it the craftsman learns to know the value of the scientist's work and revises his previous estimate of the scientist's impracticability. By it the scientist learns to value the knowledge of the craftsman and to understand that the craftsman's inability to express in words the great power which is in him has long hidden a treasure of knowledge which might have been available.

"The craftsman and the scientist have long been separated by want of an esperanto, a language of common meaning. Some day, it may be, one who is both craftsman and scientist will translate these thoughts into a common medium of expression when much to the surprise of both many ancient controversies will prove to have been different expressions of the same idea."

* * *

Building Sidewalks with a Portable Central Mixing Plant*

Unusually rapid progress in building concrete sidewalks in Wood River, Ill., was secured recently through the use of a portable central mixing plant.

In several communities central mixing plants have been used successfully in sidewalk construction, but usually such mixing plants were permanent installations. The possibilities of a portable central mixing plant installed in a central location primarily for one job have been demonstrated by the Crandall Lumber and Hardware Co., Wood River, Ill., which worked with the Kribs Construction Co., Edwardsville, Ill., in supplying concrete for six miles of sidewalk.

As the walks under construction were in opposite ends of the town, the contractor placed a three-bag paving mixer in the material yard of the Crandall Co., midway between the two jobs. Concrete for the base was mixed in this plant and delivered to the jobs in trucks. Concrete dumped in place from these trucks was immediately spread and tamped. The top course was mixed in a small mixer at the site of the job and was placed as rapidly as the base was prepared. Finishing was done by means of a long handled steel trowel. After sufficient hardening, a light layer of sand was spread on the walk and sprinkled at intervals for several days.

In spite of wet weather, unusually rapid progress was made by this system.

* * *

Fires Originating from Outside

The Wisconsin Concrete Products Association has recently advised its members that practically every

*Courtesy Universal Portland Cement Co., Chicago.

fire rating organization keeps a very careful record of the origin of fires in the territory in which they establish rates and that it is an established fact that between 30 and 40% of fires in residences are caused from external sources. A concrete masonry house, with a non-combustible roof, is practically immune from fires originating on the outside. In many cases, where buildings are close together or where a high wind occurs during the progress of a fire, a concrete house may serve as a fire stop and thus prevent a general conflagration.

In reply to the assertion that webs crack due to uneven expansion under fire conditions, the Wisconsin Association points out that in no instance, during fire tests recently conducted at the Underwriters' Laboratories, Chicago, did more than 70% of the webs crack, and the uncracked webs were rather evenly distributed over the entire exposed area. In this case, the uncracked webs are at least as effective as the usual headers in an 8-in. brick wall, so that the entire wall, after fire exposure, is substantial like that of a brick wall, with headers every 7 or 8 courses. This comparison was made by A. R. Small, of the Underwriters' Laboratories, in his discussion of the Report of Committee P-5, Fire Resistance of Concrete Building Units, in the 1924 American Concrete Institute *Proceedings*.

Direct Mail Advertising of Building Units

The California Tylite Co., making light-weight building tile at Glendale, Calif., whose plant was described in CONCRETE recently, believes in persistent direct mail advertising. It is using a series of 15 blotters designated as Messages Nos. 1 to 15. Each one carries the name and address of the California Tylite Co. in the lower right corner, the insignia of the Associated Concrete Industries in the upper right corner, the following in the lower left corner: "Tylite complies with the Building Ordinances of Los Angeles and other Southern California cities," all enclosed in a neat border and printed in blue. Each one of the series bears another message in red—each message different, from 1 to 15. These brief selling talks are as follows:

1. Good, clean, well-selected aggregate and any brand of standard cement, mixed properly with drinkable water—and you have—CONCRETE. NOT CEMENT.

2. A common error is to speak of a tile, brick, pipe, or any article made of CONCRETE as a CEMENT tile, brick, etc. Cement is only one part of the "mix."

3. Concrete today enters into our building program extensively. It is used in roadways, sky-scrapers, silos, and hog-troughs on the farm, interior and exterior trim on large buildings, etc. Why not in the building unit to carry the load in smaller structures?

4. How often have we read in the newspapers—"The community is to vote bonds for better fire protection." Using TYLITE in the construction of your home, flat, apartment house, or store building is "fire protection" and does not cost what you might imagine.

5. The tendency of the times is toward better structures. Why not ask us a question or two? Never too late to find out about TYLITE.

6. Modern automatic machines do many things—some of them are almost human in their workings. TYLITE is made on automatic tile machines, using good concrete as the material to shape the tile.

7. Too much water is as bad as too little in good concrete. We are making good concrete in TYLITE. Impartial laboratories show in their test reports to us that we do.

8. If we do not make a first-class tile, it cannot long endure. "Concrete with a conscience" is more than a motto with us.

9. Merely to talk about TYLITE, to tell of its economies, strength, endurance, etc., seems out of place in this modern age of concrete. We know there are some questions in your mind about it. Our business is to explain. We rest on your judgment.

10. To say a thing is absolutely "fire-proof" is making a broad statement. We saw the San Francisco fire. We say TYLITE is 100% fire-retardant—and that's something worth considering.

11. Had there been several dwellings in the path of the Berkeley fire built of TYLITE—we will wager there would not have been such a sweeping destruction. Sand, rock, and cement do not burn.

12. TYLITE is made in three sizes: 5 x 8 x 12—5 x 4 x 12—5 x 6 x 8. The larger size is the "standard tile"—has the wall displacement of six ordinary bricks with a 1/4 in. mortar point. The smaller sizes are for use around openings, partitions, etc.

13. Suction or absorption *must exist* in a masonry unit. "Low absorption" in a tile, brick, stone, etc., slows down the workmen and opens a way for "slippage in the wall." TYLITE meets the specifications of the American Concrete Institute, the recognized authority on this subject.

14. The voids or openings in TYLITE make for a hollow wall. Electric conduits can be run inside the openings.

15. TYLITE—A natural base for stucco or plaster; the "bond" between them is perfect. No peeling, cracking, or breaks. Let us prove it!

These blotters are being mailed to a list of architects, general contractors, and building companies, etc., over a period of fifteen weeks. There will be a lapse of two weeks between the first mailing and the mailing of No. 2, this to give the Tylite Company a chance to check up on any bad addresses. Then in regular order, the messages will be mailed to reach the recipient about Wednesday of each week.

"Behind the series of messages is the thought to acquaint the prospect in as simple a language as possible, what the product is," says Manager Hanley, "and in a friendly way, horn in on his construction sense. We certainly hope the effort bears fruit."

Water, Oil and Gas-Tight Tanks

BY DR. B. N. DEY, D. Sc.

A few extracts from Dr. Dey's observations (based on research, experiments and actual construction), as embodied in his thesis on the subject, Glasgow University.

Concrete ideally reinforced with steel . . . is better suited for water-tight work,—and indispensably necessary for gas-tightness,—than ordinary concrete, however rich mixture is used. . . .

All water-proofing agents are merely palliatives. . . . The addition of so-called integral water-proofing compounds will not compensate for lean mixtures, nor for poor materials, nor for poor workmanship in the fabrication of the concrete. Since in practice the inert integral compounds (acting simply as void-filling material) are added in such small quantities, they have very little or no effect on the permeability of concrete.

Conditions essential to secure perfect water-tightness which is the first requirement for gas-tight work: Specialized design of reinforced concrete, which should be treated as having intrinsic properties (e. g. monolithic). Relative scantlings of members (found by actual results). Design and special fabrication of reinforcements and of molds.

The ideal mixture of concrete (proportion of cement and aggregate, as determined by research and actual results). Selection of aggregate and grading of same. Placing of concrete and steel.

No additional treatment or waterproofing, e. g. surface coatings, foreign ingredients, membranes, to be allowed.

The several successful installations of gas-tight purifier tanks, in daily use, all over the country, have been built to the design and specification, in which all the findings of this thesis were strictly adhered to.

Low first cost, no upkeep, effective gas-tightness of these reinforced concrete tanks, were the reasons of their adoption by the Glasgow Corporation in the largest installation at Provan Gasworks (1921-1923).

Books

Practical Bricklaying, by Howard L. Briggs and William Carver. Size 5 in. x 8 in.; cloth cover; 224 pp.; Price, \$1.75. McGraw-Hill Co. Inc., New York City.

This handbook of instruction and manual for journeymen bricklayers and bricklaying apprentices describes the materials, tools and equipment with which the bricklayer works and explains the approved methods of handling them.

The book gives practical information on all the usual bricklaying jobs and shows how to go about the work to finish it quickly and satisfactorily. It is a compilation of useful information accomplished through the cooperative efforts of architects, practical bricklayers, and practicing contractors. It is written in the language of the mechanic. The title names and phrases of the various materials, tools and methods of using them are such that can be understood by every man familiar with the business and it is commended not only to apprentices but to journeymen bricklayers.

Reinforced Concrete Design, by G. P. Manning, B. Eng. (Hons.) Assoc. M. Inst. C. E.; 484 pp.; illust.; Longmans, Green & Co., London, England; 6 in. x 8½ in.; Price \$7.00.

In this work, the author has aimed to establish methods of design suitable for use in a civil engineer's office, the work being based on the methods which the author has found in use and which he has himself used in actual designs. The subject matter is treated from the point of view of the engineer designer. Figures, dimensions, sections and stresses have been employed to a large extent although the underlying methods are capable of general application.

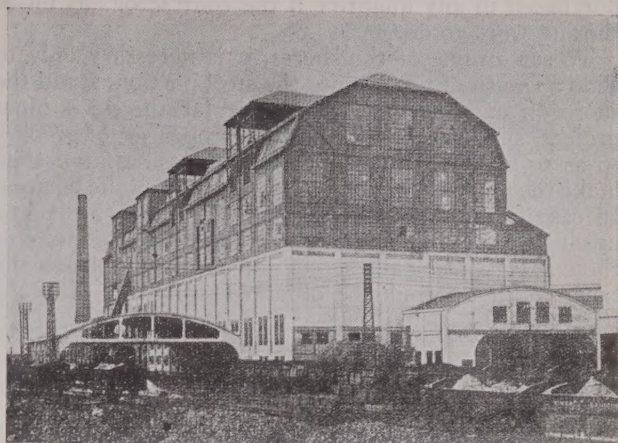
The author states that the diversion between the calculated stresses in an elastic structure and the actual stresses in a reinforced concrete structure and the possibility of rearranging the stresses by rearranging the steel, which have been understood and used by experienced designers for years, have led him to formulate his principle of greatest strength. It is pointed out that the theory of the elastic structure is quite unable to explain either of these phenomena and what is more surprising, is that most writers on the subject appear to be totally unaware of these fundamental and very vital principles. The book is intended for present day use and with this idea in view the author has given the usual theory of elastic structures while endeavoring everywhere to point out that this theory does not apply exactly and can only be relied on as furnishing a very rough indication of the stresses in actual structures as built.

This book is conveniently divided into chapters, (accompanied by tables and diagrams of design data), dealing with the various units which go to make up a reinforced concrete structure.

Reinforced Concrete Coal-Washing Plants

The accompanying illustration shows the coal washing plant at Somain, of the Aniche mines in France, where the coal storage, substructure, closed as well as open train sheds for receiving and shipping, are built in reinforced concrete, while the superstructure, containing the screening and washing machinery, is constructed of steel and tile.

These coal "washeries" have just been reconstructed, after having been entirely demolished by the Germans



during the war, and represent the most modern methods used in France to date. The engineering contractor, M. Louis Grasset, in Paris, has built this plant, as well as several others since the war, according to designs by Hennebique.—*Mines, Carrieres, Grandes Enterprises*.

A Pipe Advertisement



The picture shows Spark Plug. This display mounted on a float was made at Longview, Wash., during the new city's recent Pageant of Progress, which was to celebrate the progress made in the last two years, building a new lumber center city in which concrete has played an important part. This particular float carrying Spark Plug was the work of the Longview Concrete Pipe Company."

Shore for Job Economy

A new shore, put on the market recently by the Universal Form Clamp Co., 976 Montana St., Chicago, is made up of a hollow rectangle of steel inside of which a 4x4 can be placed for rigidity. Instead of a gravity lock, the end of the 4 x 4 is given rough adjustment and support by means of a T iron that rests in slots cut into the steel frame at frequent intervals. Final adjustment is given by turns on a screw jack at the base of the shore. The manufacturers say that they have had tests performed showing conclusively that a load of 15,000 lbs. will not cause any settlement. The manufactured portion of each shore weighs 36 lb. The adjusting screw at the bottom is 1¼ in. in diameter, and it has a vertical adjustment of 3 in. The 4 x 4's usually are obtainable in random lengths, and they very seldom have to be

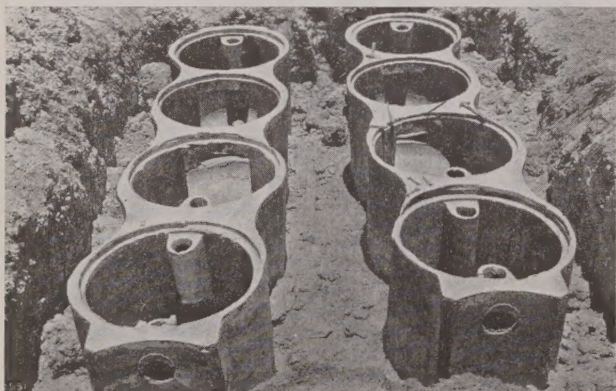
purchased in any quantity if the contractor has much shoring work to do.

To set up one of the shores, it is necessary only to slide a length of timber into the steel portion, stand the shore on end and determine how far the 4 x 4 must project, slide the T iron into the proper set of grooves so as to give the rough adjustment desired, and then make the final adjustment with the screw on the bottom. In case forms should be sagging, they may be jacked up during the pour by the insertion of one or more of these shores, using the screw adjustment to obtain the same result as would be obtained should an ordinary screw jack be used.

Monolithic Septic Tanks in Units

The picture shows a septic tank in two units, each of four chambers, for the Firch Apartments, one of numerous installations at Coral Gables, Fla., done with a system of steel forms developed (and patent pending) by the Sanitary Septic Tank Co., Inc., 427 N. W. Second avenue, Miami, Fla. The forms are being sold to subdivision promoters, contractors and concrete products manufacturers.

The system has been designed and installed under the Florida state sanitary code which makes definite specifications governing all septic tank work. From the producers we have a description of the operations with this septic tank system:



All parts of the forms are interchangeable and fastened together by bolts or clamps. Each core unit, or inner form is made up of a semi-spherical bottom, which gives a bowl shaped bottom to the chamber with no dead pockets or square corners. To this is bolted a cylinder made up of four sections. Two of these sections carry baffle forming recesses and in making up the cylinder are placed diametrically opposite so as to form incoming and outgoing baffles. The outer form is made up of two circular end pieces and the necessary number of curved spacers to form the number of chambers required. In construction, a hole of required dimensions is excavated; a concrete mat poured three inches thick and of sufficient length and breadth for the number of chambers to be poured. After this concrete mass has settled, say in thirty minutes time, cores or inner forms are set on for as many chambers as may be desired.

Where more than one chamber is desired for sludge capacity, the large opening is formed by a special box placed between cores, so as to block out the baffles. Next, two circular ends of outside forms are set two inches from the outside diameter of the end cores and connected for the outside form by using as many curved spacers as necessary. Three, four and five chambers are formed by adding the proper number of cores and curved spacers. Spacers are braced by tie rods where necessary. With three sets of forms tanks are built for any range of capacities from one chamber to five or a working combination to keep two crews pouring.

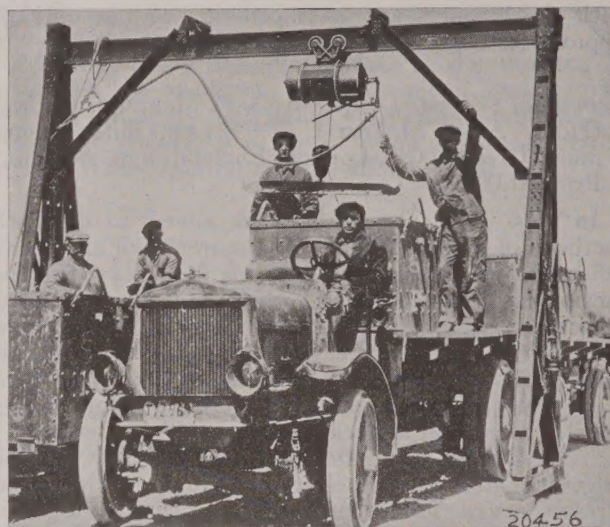
Aside from forms and small tools, needed equipment is a Ford one-ton truck and $\frac{1}{2}$ bag, four-wheel mixer on pneumatic tires. Material required per chamber and mat, 46 in. outside diameter by $44\frac{1}{2}$ high is: $4\frac{1}{2}$ bags cement, 1 yard sand, 1 bag lime.

The manufacturers say of their own work in installing septic tanks that the business started April 1, 1924, and that during May, June and July they installed \$13,200 worth in tanks with an average of \$4,000 to \$4,500 per month ranging from Monolith Jr. to eight-chamber jobs.

Air-Driven Hoist

An air-driven hoist was recently used to advantage by the Hill & Hill Construction Co. in building a stretch of concrete highway near East Orwell, Ohio. Owing to existing conditions, it was decided to mix the materials for the concrete at a central plant and to transport them in steel hoppers. The steel hoppers were handled mechanically by the aid of a 4000-lb. capacity air-motor hoist drawing operative air from a $4\frac{1}{4}$ x 4 in. type 20 portable Ingersoll-Rand air compressor.

The roads leading to the work were of such a nature that heavily laden motor trucks could not pass. The task of transporting material therefor presented a very difficult problem. A railway ran alongside the new roadway but the use of this means of transportation would involve heavy expenditures if the materials required for the job were to be handled in the usual



AIR-DRIVEN HOIST TRANSFERRING STEEL HOPPER OF CONCRETE FROM RAILWAY CAR TO MOTOR TRUCK

way by manual labor, inasmuch as it would be necessary to load them first on motor trucks at the storage plant, next to transfer them to railroad cars at the freight yard and then to place the load once more on a truck at the scene of operation.

The hoist used in handling the steel hopper was suspended from an I-beam by a 4-wheel trolley. The I-beam was supported on structural steel legs, the legs and beam forming a "horse" large enough to straddle both a motor truck and a freight car. With this arrangement, it proved easy to shift the loaded hoist along the I-beam from the freight car to the truck or vice versa. An air-driven motor was geared to the trolley wheels. The ease with which the hoist was operated enabled one or two men to do the work that would have required a dozen if it were done manually.

If there is a man in overalls in your employ who is a skillful workman and takes pride in his job—let's hear about him and what he does.—Editor.



Part of the fleet of 23 Autocars in the service of the Belmont Trucking Company of Indianapolis

"No after-sales service in automotive industry can compare with Autocar"

Belmont Trucking Company, Indianapolis

The Belmont Trucking Company of Indianapolis, owners of 23 Autocars, have standardized on Autocars, not only because their three years of experience have proved Autocar superiority, but because many of their customers insist upon the use of Autocars.

For example, Mr. C. E. Hair of the company, has recently written to the Autocar Direct Factory Branch in Indianapolis:

"We have just undertaken a transportation service on a large road contract where the contractor insists on Autocars, and Autocars only. This is 18 miles of road in the neighborhood of Madisonville, Kentucky.

"When we sent our first trucks on this job, the contractor had had very little experience with Autocars, but he now finds that with them he can handle his work with much greater efficiency. He had previously been much concerned because of the necessity of completing the road by December 1, but with Autocar equipment now on the job he is confident of completing his work within the contract time."

Autocar efficiency and durability, combined with the distinctive Autocar short wheelbase handiness, are making Autocar trucks the choice of leading road contractors everywhere.

The Autocar Company, Ardmore, Pa.

ESTABLISHED 1897

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Wherever there are roads to build

Flory Hoist—A Correction

The address of the S. Flory Manufacturing Co., Bangor, Pa., was incorrectly stated to be Allentown, Pa., in the article on page 203 of the November, 1924, issue of CONCRETE, describing the Flory hoist with Fordson gasoline motor. The Flory company has been located at Bangor, Pa., for a number of years.

Trade Publications

Maintenance may at one time have been relatively a simple matter of keeping buildings in good paint condition, or the roof in repair; but the changing needs of industry today have altered that considerably. The day when the millwright or the boss carpenter attended to "upkeep" is long since gone by. Maintenance has developed into so important a work that the "handy man" can no longer take care of this work satisfactorily; it requires the attention of men especially trained—men with engineering education, very often. In order to help the man who has charge of the maintenance of buildings and equipment in large institutions, the Truscon Laboratories, Detroit, have prepared a wall chart, or "Maintenance Map," as they call it, showing in detail various maintenance requirements of buildings with suggestions of what to do in each case. The "Map" consists principally of a large colored cross-section of a modern manufacturing building; each maintenance requirement being indicated by a system of numbers and arrows. Features on this large cross-section are further detailed and emphasized by smaller illustrations at the bottom. The map is printed in four colors, on heavy enamel paper, 22 in. wide x 32 in. high, finished with metal strips top and bottom, and with wall hanger attachment.

The *7-S Mixer Book* is the title of a booklet in which the Leach Co. of Oshkosh, Wis., formerly the Oshkosh Manufacturing Co., publishes reports of inspections made by the Robert W. Hunt Co., on different makes of mixers in common use.

With the idea in mind that the careful buyer must draw his own conclusions and that no mechanical device can be perfect, reports on the inspections are reproduced in the booklet to give the contractor the findings of a detached critic and to permit him to arrive at his own conclusions. The names of the different mixers inspected are not included.

In addition to the report referred to, the booklet contains illustrations and descriptive matter on the operation and construction of the Leach-Oshkosh-7-S mixer.

Three new folders have been issued by the M. & M. Wire Clamp Co., Minneapolis, Minn., entitled *Your Shoring Problems Solved*, *M. & M. Form Clamps Have Perfect Adjustment* and *How One Man Can Easily Do the Work of Two Leveling Concrete*. The first describes the M. & M. splicing clamp for placing shores. This clamp has a hinged filled back so that the clamp can be used for surface or rough 4 x 4's and the change over can be made very easily in a short time. The M. & M. Form Clamp is described as a clamp that can be folded up compactly and can be placed on the job with the tools form builders have in their tool boxes.

In the last named folder, the M. & M. target is described as a stamped metal flag which is used in place of the wire flag. This is designed to eliminate labor in making up the tagret and to speed up placing them as well as to provide something more rigid than the wire.

Under the heading *Snow Insurance*, the Barber-Greene Co., Aurora, Ill., has issued a booklet describing and illustrating Barber-Greene Snow Loaders. An interesting table included in this booklet gives the seasonal snow fall or yearly average snow fall for cities in many parts of the country.

The booklet is 8½ in. x 11 in.; 24 pages. Numerous illustrations show the snow loaders in operation in different cities and complete specifications for the equipment are included.

Lakewood Concrete Placing Equipment, Bulletin No. 23-E issued by the Lakewood Engineering Co., Cleveland, Ohio, not only describes the concrete chuting plant and the different ways in which the various types are used but discusses also, the consistency of concrete; slope of chute lines; relationship in size of buckets, hoppers, etc.; capacity and length of life; and the steel tower. Numerous actual installations of chuting plants and the jobs on which they are used are described and illustrated. Lakewood counterweight chutes; floor hoppers, flexible chutes, feed hopper cars and clamshell buckets are among the types of special equipment covered in the catalog.

Cement Goods Machinery is the title of a catalog being distributed by Broe & Company, 16 California St., San Francisco, Calif., descriptive of a line of concrete products equipment, being imported from Copenhagen, Denmark, for introduction to the cement products plants in this country.

Among the various pieces of equipment described and illustrated in

the catalog are: stationary and portable mixers; transmissions for machines; cement roof tile machines; molds for wet-molded ridge tiles; brick machines; block machines; molds for chimney ridge; machines for the manufacture of flag stones; molds for pavement curbs; ornamental vases; and crowns; pipe tamping machines; molds for pointed bottom and egg-shaped pipes; fence post molds, crushers and tools for cement and concrete work.

The catalog is 6¼ in. x 9½ in.; 96 pages with paper covers. Separate booklets and folders are also issued describing in detail the individual types of machine.

Apply Stucco with Air Gun

Paasche Air Brush Co., 1909 Diversey Parkway, Chicago, is producing compressed air equipment for the application of stucco and other cement and sand mixtures. It is very small and compact. The type 74 portable outfit, capable of supplying 14 cu. ft. of free air per minute with the compressor, has a 9-gal. portable pressure tank. The air is supplied at 100 lb. It is necessary in mixing batches for use with this equipment that care be taken with the proportions, so that there will be ample binder in the mix to hold the granular or coarse materials in suspension. The company has used a mixture of 5 gallons of torpedo sand to 5 gallons of cement and about 1 gallon of hydrated lime. This is first thoroughly mixed and then placed in the tank through a screen having ⅛-in. opening.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 1807 East Grand Boulevard, Detroit, Convention, Chicago, February 24-27, 1925.

American Concrete Pipe Association; M. W. Loving, Secretary, 111 West Washington St., Chicago.

American Engineering Standards Commission; Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth Street, New York City.

Associated General Contractors of America; G. W. Buchholz, Secretary, 1038 Munsey Bldg., Washington, D. C.

Associated Metal Lath Manufacturers; 123 W. Madison St., Chicago; Wharton Clay, Commissioner.

Building Officials Conference; Rudolph P. Miller, President, Fred W. Lumis, City Hall, Springfield, Mass., Secretary.

Iowa Cement Stave Silo Association; H. E. Kilmer, Secretary, Oskaloosa, Ia.

Iowa Concrete Products Association; Ross Dowell, Secretary, 405 Hubbell Bldg., Des Moines.

Mid-West Concrete Products Association; D. R. Donlen, Secretary-Treasurer, 4340 Marcy St., Omaha, Neb.

National Association of Manufacturers; John E. Edgerton, President; Henry Abbott, Treasurer; George S. Boudinot, Secretary, 50 Church St., New York City.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High Street, Columbus, Ohio.

The National Concrete Stave Silo Association; W. G. Kaiser, Secretary, 111 West Washington St., Chicago.

National Crushed Stone Association; A. P. Sandles, Secretary, 405 Hartman Bldg., Columbus, Ohio.

National Housing Association; Lawrence Veiller, Secretary and Director, 105 East 22nd St., New York City.

The National Lime Association; Mather Bldg., Washington, D. C.

National Sand and Gravel Producers' Association; T. R. Borrows, Acting Secretary, 903 Munsey Bldg., Washington, D. C.

Portland Cement Association; William M. Kinney, General Manager, 111 West Washington Street, Chicago.

Wisconsin Concrete Products Association; D. R. Collins, Secretary-Treasurer, Milwaukee.